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Updating the Natural Science Exhibits at the Maria Mitchell Association

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Abstract

This report, prepared for the Maria Mitchell Association, explored ways to update the existing exhibits and increase kindergarten through fifth grade visitation to the Natural Science Museum. The current exhibits were evaluated based on content and aspects of exhibit design. We developed and modified six interactive prototypes regarding erosion and bird adaptations. By working together with local schools, we determined key obstacles preventing class visitation. Through our analysis of surveys, observations, and interviews we developed recommendations for the Association.

Authorship

Every aspect of this report was written and edited by all three members of the group. Molly Congdon contributed heavily in the planning and scheduling of many logistics within the project, with help from Victoria Valencia. For most interviews with teachers, Victoria represented the group as lead interviewer, while Molly and Alex took notes and made sure the interview went along smoothly. While building prototypes, each group member was in charge of a couple of prototypes. Molly not only conceptualized how to do the Erosion Book, but also did most of its construction. Victoria oversaw the building and presentation of the Bird Feet Adaptation prototype, while Alex built and managed the various Bird Beak Adaptation prototypes. While observing visiting children testing our prototypes, Molly recorded observations on the book, Victoria observed the interactions with the Bird Feet Adaptations, and Alex presented and recorded for the Bird Beak Adaptations. When analyzing data both from interviews and visitations, we divided up the work to maximize efficiency and edited each other's sections to check for continuity. The final assembly of sections was mostly done by Molly, due to her vast knowledge when dealing with large Word documents.

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Table of Contents

Table of Figures

Table of Tables

1. Executive Summary

1.1 Introduction/Sponsor's Goal

It has been the goal of every museum since the end of the 19th century to act as an educational venue to the general public. To accommodate for changing trends in society, museums are constantly reinventing their exhibits and programs to increase their effectiveness and appeal. These institutions strive to attain both new and returning visitors.

1.2 Problem Statement

The Maria Mitchell Association acts as a valuable source of history that helps remind visitors of what makes Nantucket such a unique paradise to many rare and exotic plants and animals. It is the goal of the MMA to help its visitors to become amateur naturalists through the combination of its programs and natural science exhibits. Currently the exhibits in the Natural Science Museum located in the Hinchman House are seen as "the weakest link in [the MMA's] education and research programs"(Schulte, 2008, 4). Many of the exhibits are comprised of an assortment of donated mounted birds, small mammals, and other specimens found on Nantucket. The exhibits also consist of numerous: wall panels, glass case displays, live animals in representative habitats, and potted plants during the summer. Executive Director and sponsor Dr. Janet Schulte informed us that the project's audience is children in kindergarten to fifth grade; however, many staff members have described the exhibits as inaccessible to visitors with no prior knowledge of the topics presented. The MMA also expressed a need to increase visitation since many islanders and school teachers do not know about the Natural Science Museum or its resources. The challenge posed to our group was to increase the visitation to a museum that is little known to the locals, and to update the exhibits.

1.3 Goals and Objectives

The overall goal of this project was to update the natural science exhibits in the Hinchman House and to encourage local school children from within our target age group to visit the museum. To accomplish this we established two objectives to be completed:

1. To update the current natural science exhibits by making them more interactive and hands-on.
2. To determine how to increase kindergarten through fifth grade school group visitation.

1.4 Process and Methods for Objective 1: Updating Exhibits

In order to successfully update the exhibits, first we had to determine the effectiveness of the current exhibits. We began by interviewing various staff members to see how they felt about the museum, what its goals were, and whether they saw the Natural Science Museum reaching those goals. After this, we set up an open house. This was a free event, open to the general public of Nantucket. We used this event as an opportunity to observe visitors as they walked through the museum without a guided tour, checking for which exhibits they looked at and how they interacted with them. The data collected from this event as well as our interviews with the staff informed our decision to create prototypes for the potential new exhibits.

At the open house, we distributed feedback surveys to visitors to determine how much they enjoyed the exhibits. These surveys gave us an idea of what the local population likes about the museum currently and what they felt should be changed. We used this input, in addition to the observations gathered that day, and the interviews with staff to determine the topics for our prototypes. In general, we looked more closely at exhibits that were ignored during the open house for prototyping. We also paid special attention to what staff members said they would like to see in the museum.

When interviewed, most staff members expressed interest in exhibits displaying the recent changes in Nantucket's shoreline and overall geology. As a result, we built prototypes that focused on the erosion of Nantucket and on the purpose of various types of bird adaptations. The first prototype based on erosion was modeled after pictures from the Williams-Mystic program. These pictures measured the distance between a building and a costal cliff using a human chain. The second group of prototypes was based on an existing exhibit about the evolution of bird beaks and an adaptation exhibit located in the Museum of Science Boston. These prototypes were all presented in a hands-on manner that engages the visitors while allowing them to draw their own conclusions about the topics presented.

The erosion prototype was a storybook aimed at younger children, showing a shrinking shoreline with each turning page. In a simplified manner it described the process of erosion which continuously affects the island and the methods by which this occurs, such as wind, incoming storms, and global climate change. This book engaged visitors by relating the island as a whole to their personal lives.

The bird adaptation prototypes were analogy-based exhibits that described why birds have certain types of beaks and claws in order to survive. For this prototype, we used common household and office items to represent claws and beaks. We also invited the visitors to use them in two different situations per feature: the appropriate one for each adaptation and one that is better suited for another adaptation.

We brought in school groups from Nantucket Elementary School, New School, Lighthouse School, and the Boys and Girls Club to test our prototypes. Over the course of the following weeks, we made several iterations of the aforementioned prototypes. As different groups came in, we edited the prototypes until they were the most effective and appealing that we could make them.

1.5 Results and Observations for Objective 1: Exhibit Updates

Our early results from the Open House yielded several trends that helped us create effective prototypes. It was observed during the open house that exhibit placement affected how well people were drawn to a specific exhibit, while label length contributed to how long a visitor paid attention to the exhibit. As we expected, it was also observed that the interactive exhibits attracted the attention of the children much more than the other exhibits within the room. While some rooms, such as the Main room, were generally overlooked, other rooms, like the Live Animal room, received the most attention and praise on the feedback forms.

1.6 Process and Methods for Objective 2: Increasing School Visitation

In order to reach our second goal of increasing school visitation to the Natural Science Museum, we met with teachers of various grades from schools in the area. We interviewed teachers from Nantucket Elementary

School, New School, and Lighthouse School. During our interviews, we determined how they are teaching STEM topics, whether the Natural Science Museum is beneficial to their curriculum, and what obstacles are keeping them from visiting the museum with their classes. We also looked into the Massachusetts Curriculum Frameworks to determine general topics taught to our target audience.

1.7 Interview Results

When asked what some major obstacles for bringing classes to the Hinchman House for field trips are, all of the local teachers mentioned cost. Other common obstacles mentioned included tying the exhibits into the frameworks, lack of time, and that the size of the exhibit space is too small for their classes. These interviews also provided us with a list of topics taught to our target audience and so a list of topics for future exhibits.

1.8 Prototype Results

Our final prototypes were the result of modifications made after several school visits to the Natural Science Museum. The alterations were made as a result of our observations and the analysis of the children's ability to understand the concepts and manipulate the prototypes. Throughout all of the school group visits, we noticed several trends in the behavior of the children. Some of these are an overall enjoyment of the interactive prototypes, a lack of desire to read labels, and the ability to understand the presented analogies.

1.9 Prototype Conclusions

Based on all of our observations and interviews with the MMA staff, it is our conclusion that the natural science exhibits in the Hinchman House are heavily dependent on the tour. This is largely due to the lack of clarity of labels and associated text to the exhibits. Our observations have yielded that the text requires some amount of prior knowledge of the subject matter in order for the average person to walk up to it and learn something. This is contrary to what our background literature suggests should happen in a museum. One key aspect to having a successful interactive exhibit is to make it understandable to anyone, regardless of their intellectual background. On top of the difficult and unclear labels, the text is either too lengthy, too short, or in too small a font to be legible from an appropriate distance. These characteristics render the text inaccessible to both adults and children alike.

Another conclusion we made from our observations, was how exhibit placement affected an exhibit's ability to attract visitors. We observed that many of the exhibits located in the corners of the rooms and the exhibits in the main room were ignored by the visitors. It was also clearly evident from the beginning that the lack of useable space in the museum provided little room for adding on the current exhibits in already overcrowded rooms. As a result the prototypes were forced to be placed within a close proximity to one another which caused congestion in certain areas of the rooms. This was clearly evident in the bird room and live animal room where children would crowd around to see the animal or new prototype exhibit.

From our prototype observations, we have noticed several trends in the way kids prefer to learn. One such trend is, that children who are in second grade and below, do not tend to read the labels because they are just learning how to read and it is still difficult for them. For these audiences we found that the use of more visuals to portray the idea rather than text is more effective. On the other hand, children in third grade and up are much more prone to read and thus an easy way to engage them in an exhibit is to pose thoughtful questions within the accompanying text, allowing them to come to conclusions on their own. This is a great way to update an old exhibit to be more interactive without redoing the way the idea is taught.

1.10 Conclusions for Objective 2: Increasing School Visitation

From our many interviews with local school teachers, we discovered which science topics are being taught in Nantucket's kindergarten through fifth grade classes. While many of these topics, such as geology, adaptation and classification, are included in the current museum exhibits, many others are not.

These topics could be incorporated into the current exhibits to further encourage teachers to bring their classes to the museum.

From our interviews it appears that the greatest obstacle preventing classes from visiting the museum is cost, which was mentioned by teachers from all three public and private schools that we worked with. The second obstacle to getting schools to visit the natural science museum is meeting the Massachusetts frameworks. Since the public school is required to meet these frameworks, the teachers are forced to keep the children in the classroom unless a field trip is able to cover multiple frameworks. The other less frequently mentioned topics include the small size of the museum, the need for transportation, and lack of time to take field trips, the latter being a direct result of having to teach the frameworks.

1.11 Recommendations

In our opinion this project has been an overall success. We are confident that our prototype exhibits will help guide the MMA in the creation of many more interactive exhibits and that our research will help the MMA apply for grants to cover the costs of creating and installing these new changes. We also believe that our contact with the private and public schools will help strengthen the communication between the teachers and the MMA.

In regards to updating the current museum, we recommend rearranging the exhibits to help connect each of the five main exhibit rooms. We suggest that the main room focus on the formation of the island while the other four rooms focus on a different Nantucket habitat: air, land, freshwater, and sea. In regard to exhibits this project group recommends incorporating more interactive exhibits spread throughout the individual rooms as well as the museum as a whole. We further recommend placing live animals in the room that best corresponds with their habitat, i.e., freshwater fish in the freshwater room, snakes in the land room. To further improve the flow of the museum, we suggest removing some of the doors which hinder the flow of visitors in the museum.

This project group strongly suggests rewording the exhibit text to make it more informative and accessible for the children in the target audience. We recommend that the text be made concise, short and incorporate thought provoking questions to allow visitors to create their own conclusions.

To encourage school visitation, we recommend that the MMA expand their exhibits on topics mentioned by the teachers. We also suggest incorporating some of the topics that were mentioned but are currently not present in the museum. It is also suggested that the MMA offer themed tours to school groups that include a related activity. Regarding school contact, it is suggested that the MMA staff remain in contact with teachers throughout the school year, through both email and personal meetings. Lastly we strongly recommend that the MMA seek grant opportunities to help fund school visitation and programs, as well as, cover the costs associated with updating the museum.

2. Introduction

It has been the goal of every museum since the end of the 19th century to act as an educational venue to the general public. To accommodate for changing trends in society, museums are constantly reinventing their exhibits and programs to increase their effectiveness and appeal.

The Maria Mitchell Association, a small, primarily volunteer run institution open during the summer season, consists of a natural science museum, observatory, and aquarium located in several historical houses. Unfortunately, the Maria Mitchell Association has not kept up with the changing trends, maintaining its original style of exhibits. These exhibits consist of mounted animals, seasonal live animals in representative habitats and informative posters, all presented in a very factual manner, mainly focusing on identification. The Maria Mitchell Association (MMA) recognizes the need to update their exhibits to appeal to its audience of kindergarten through fifth-grade children and their teachers. As a result the purpose of this project was to update the exhibits to the MMA's Natural Science Museum and increase visitation of the previously mentioned target audience. This project group attained this goal by creating two objectives. The first objective was to update the exhibits in the Hinchman House while the second objective was to determine how to increase school visitation to the museum. This project group worked closely with the MMA to discuss how to redesign the museum's natural science exhibits and explore ways to encourage teachers to hold field trips to the museum during the off season.

In order for the MMA to update its exhibits successfully this project group studied the various types of learning that occur in a museum, the best way to update an exhibit, what defines a good exhibit, as well as the curricula of the Nantucket Public School system (NPS), local private schools and home schools. To acquire the aforementioned data, this project group conducted individual interviews with our sponsors, and kindergarten through fifth grade teachers who could benefit from a trip to the MMA natural science museum. While the data was collected, prototype exhibits were constructed and tested on museum visitors. This information will be used by the MMA at a later date to build new exhibits.

One group that the MMA was looking to attract during the off season is school groups. By working closely with the MMA’s director of education this project group was able to obtain the contact information of many teachers from both the public and private schools. The group then conducted interviews with willing teachers that inquired about the effectiveness of the museum and what they believe could be done to improve learning and visitation. These findings will be used by the MMA to update exhibits that will attract school groups with children in kindergarten to fifth grade to the museum during the off season.

The remainder of this report contains a literature review highlighting the relevant background research, the methodology and results and analysis that was employed upon reaching the project site, as well as, the resulting conclusion and recommendations that were determined by this project group. Appendices featuring project timelines and survey drafts follow the report’s references.

3. Literature Review

This chapter will cover the history of museums and their function in society. We will present a brief overview of the MMA's current exhibits and educational programs, as well as, their goals for the project. We will also discuss the types of learning styles that are prevalent in museums and the key features of exhibit design. We will also describe types of Museum-school interactions. Lastly, we will discuss other museums with exhibits and or programs similar to those desired by the MMA will be described and compatibility to the MMA.

3.1 History of Museums

"As recently as twenty years ago museums were widely considered dusty anachronisms" (Falk & Dierking, 2000, 2), devoted to studying and displaying items of historical significance. Over the years however, museums have transformed into gathering places of artifacts, items and ideas that aid in an individual's comprehension of the surrounding world. Dissimilar to classrooms, libraries and other formal educational centers where knowledge is primarily gained through the literature, textbooks and spoken word determined by the teacher, museums provide an informal learning setting where visitors can test ideas and seek information by observing and interacting with each other and exhibits. In museums the individual maintains the control of the ability to learn in an unstructured manner and focus his or her learning to topics of interest. Even school children who are led through museums by educators still possess the ability to learn in a free-form way. Alma S. Wittlin (1970) proposes that museums have three main functions as "depositories devoted to the preservation and conservation of [historic] objects …centers for research and educational agencies" (Wittlin, 1970, 1). This idea of a calm, meditative, conservation museum has changed in recent decades as "the number of museums that offer this kind of experience is diminishing" (Pittman, 1999, 1). According to Pittman (1999) museums are increasing their focus on their surrounding communities. Today museums also provide exhibits, programs and forums that reveal the diversity and needs of their communities.

Before the late eighteenth century the public museum did not exist. “The collections that preceded them were connected with places of worship, belonged to groups of people who shared a common interest or, in their majority, to private individuals” (Wittlin, 1970, 3). Museums originally opened in Europe, while it was not until 1773 that the first museum in the United States was established in Charleston, South Carolina. These early museums were primarily focused on “the practical application of the natural sciences to the mundane affairs of the community” (Wittlin, 1970, 106). By relating their exhibits to everyday life, early museums were able to make advanced scientific topics understandable to the layman’s mind. Although not all early museums were like this; the Pearle Museum, founded in 1786, displayed exhibits with two main goals; to entertain and educate its visitors (Skramstad H., 1999). It has not been until recently that museums have broadened their educational roles by including social events along with workshops, educational outdoor excursions and indoor exhibits.

3.2 Maria Mitchell Association

The MMA takes pride in its variety of “hands-on-learning” educational programs for all ages and backgrounds. The association offers everything from summer classes and school field trips, to adult workshops and fishing outings. The Field Geology Workshop takes participants to the terminal moraine of Nantucket to observe glacial erratics and fossils located in the island’s eroding cliffs. The MMA, in conjunction with Shearwater Excursions, takes students on Seal Trips and Whale Watches. These voyages allow passengers to witness the creatures in their natural environment while listening to discussions about their traits and biology. The Loines Observatory is used to give lectures and observational tours of celestial bodies and constellations in the Astronomy Workshops. These workshops also feature a presentation of the research telescope and its machinery. The museum also features interactive classes such as “Growing Up Wild”. This program for children four to six years of age covers topics such as the life cycles of invertebrates.

In conjunction with their outdoor excursions and workshops, the MMA also contains indoor museum exhibits. The astronomy exhibits showcase Maria Mitchell’s accomplishments as an astronomer and the MMA’s ongoing research. The natural science exhibits highlight the habitats, species, vegetation and geological history of the island as well as the surrounding environment. Currently, many of the exhibits are static, primarily containing mounted birds and a few other animals, illustrative wall panels and text descriptions; although there are a few simple matching displays that provide basic interaction. There are large glass cases identifying various bird nests, types of sponges, preserved organisms, seashells and a variety of skulls. Glass cases containing potted plants are in the museum during the summer season and live animals in representative habitats are found in the live animal room. Most of these animals are captured during the spring by staff and locals for display during the summer. Once the museum closes for the off season some animals are released back into the Nantucket wild to be recaptured the following year. Unfortunately, many of these exhibits are old and reflect dated design criteria.

The MMA anticipates that reconstruction of the natural science and astronomy exhibits will transform the “antiquated collection of static exhibits to an engaging primer on the natural world with full use of modern demonstration technology” (Shulte, 2007). To establish the most effective exhibit that will achieve the goals of the MMA, a variety of topics need to be considered. Different learning methods must be analyzed as well as the various types of exhibits to determine the style of displays that will be best for the visitors. Interactive technology must be explored to determine what is available and appropriate for a museum setting. Exhibit design must also be researched so that the exhibits proposed can be suitable for all people, including the disabled.

It is the MMA’s hope that the improved exhibits will encourage local schools to visit the museum during the off-season and provide opportunities to create further educational outreach programs that can be utilized by the Nantucket Public Schools (NPS) and other school systems during the school year.

3.3 Learning in Museums

“The prevailing model for understanding learning in museums runs something like the following: Visitors come to museums, look at exhibitions, or participate in programs, and if the exhibitions or programs are good, the visitors learn what the project team intended…, [however], data would suggest that the model, if not completely wrong, at the very least is seriously flawed, (Falk & Dierking, 2000, 3-7).” To address this flaw, the various ways in which people learn in museums must be studied in more detail. First the main types of learning that occurs in museums must be briefly looked into. The following section will concentrate on interactive learning, since this type of learning is strongly promoted by the MMA. Finally, learning in a family environment while at the museum will be discussed. This type of learning will equally be important since the second objective of the project is to promote family visitation to the MMA.

3.3.1 Informal Learning

One of the main objectives while in Nantucket will be to update the MMA’s exhibits so that they are more interactive and interesting. Falk and Dierking (2000) define interactive learning as when “visitors have the opportunity to control their own learning” (84). Such learning is often referred to as informal learning and is considered the main type of learning that occurs in museum settings. Logic dictates that the freedom to choose what one learns implies that they have some degree of interest in the subject and thus have motivation to pursue the matter by either interacting with the exhibit or reading the available material. Time and again, it has been shown that when learning occurs because people are self motivated, the quality of learning is much higher than when the topics are forced upon them (Falk & Dierking, 2000).

3.3.2 Interactive Learning

"To be effective as teaching tools, [museums] need to be highly intrinsically motivating at every step of an interaction in order to sustain involvement by an audience who views their visit primarily as a leisure activity (Allen, 2004, S17)." Recent studies on how the human mind learns new information may have the answer museums have been looking for. Lately, cognitive research has indicated that humans learn and retain information much better if they come to conclusions on their own rather than being told what conclusions to draw (Renkl & Atkinson, 2007). Furthermore, the length of time spent at any one exhibit also has a significant effect on people's ability to retain what they learned, (Serrell & Adams, 1998). In an attempt to increase hands-on learning activities, many museums are transforming their educational programs for children, endeavoring to make children's visits more dynamic, engaging and enjoyable. To help capture and sustain the interest of today's children, museums are integrating computers into their exhibits, (T. Hall & L. Bannon 2006). As stated in previous sections, the Maria Mitchell Association is one museum organization that would like to incorporate such changes into their exhibits.

In order to implement interactive exhibits, it is best to have a better grasp of what it means to learn interactively. Renkl and Atkinson (2007) point out three theoretical stances that researchers use to analyze interactive learning: active responding, active processing, and focused processing. "The first two stances were introduced by Mayer and colleagues (e.g., Robins and Mayer 1993) whereas the latter (i.e. focused processing) is a differentiated version of the active processing stance." (Renkl & Atkinson, 2007, 236) The active responding stance stresses the visible interactions between the subject and his/her interactive environment. The second, and most commonly adopted, stance is the active processing stance. Also known as the constructive position: "it assumes that knowledge cannot be imparted on the learners but has to be actively constructed by information processing in the working memory", (Renkl, & Atkinson, 2007, 236). Finally, the last stance The Education Psychology Review Journal mentions is a differentiated version of active processing, which they call focused processing. Focused processing is much like active processing in that the subject constructs memories in their working memory. However, in active processing the subject can follow all the instructions/prompts but still not take away what the exhibit intended to teach, whereas in focused processing, more attention is placed on the core ideas and concepts. An example the article described is a computer-based economic game where the user ran a jeans manufacturing plant. "In this case, many learners were so preoccupied with the jeans not selling that they focused on keeping their stock rather empty. Unfortunately, this strategy was counterproductive to the original goal of the task, which was learning to maximize profits," (Renkl &Atkinson, 2007, 236-237). The focused processing stance not only promotes active processing but also reinforces the subject's focus on the core ideas and concepts behind the exercise.

3.3.3 Family Learning

Some experts agree that one of the most significant variables of what museum-goers take away from exhibits depends on with whom they go (Falk & Dierking, 2000). Indeed, it can be observed that a lot of museums are structured so as to meet to the needs of families. As Doris Ash observed: "family groups (and others) split into dyads or triads at exhibits and then come together again later to share meaning" (Ash, 2003, 139). This supports the idea that visiting museums as a family not only promotes more learning than going individually, but improves family dynamics and bonding. In order for such rewarding learning to occur, the various exhibits should be designed so that each individual may explore independently.

According to the Philadelphia/Camden Informal Science Education Collaborative (PISEC), there are seven main attributes that make an exhibit family-friendly: multi-sided, multi-user, accessible, multi-outcome, multi-modal, and readable, (Borun, 2008). All of these are imperative to family learning in their own way. For example, having a multi-sided exhibit means that there will not be too much congestion while a group of visitors gather around the same exhibit. This also functions hand-in-hand with a multi-user exhibit, in which multiple visitors must collaborate with one another to get the full experience of the exhibit. Multi-outcome exhibit designs encourage family discussion by presenting a sufficiently complex ideal or concept. In order for exhibits to have multiple outcomes, it is essential that they be readable, accessible to all ages, and adaptable to various learning styles and levels of knowledge (Borun, 2008). Finally, an exhibit should try to connect to the diverse visitors' previous knowledge and experiences. Obviously this can be the hardest characteristic to achieve, from the museums perspective, since the variety of personal experiences that the average visitor brings with them is so vast.

3.4 Exhibit Design

According to Beverly Serrell (2006) "design is an integral part of the exhibition environment for the overall visitor experience" (30). Every aspect of an exhibit, from its content to its layout, will affect the character of the museum in which it is on display, the types of visitors it attracts and how well it is received. Each of these may contribute to what may be viewed as a good or bad exhibit. There are many reasons to build an exhibit; a few are illustrating complex concepts through simple examples found in everyday life and bringing extremely large or small items to human scale (Veverka, 1994).

Interesting content in an exhibit is essential. In fact, this has led to a push toward creating interpretive exhibits. Interpretive exhibits spark curiosity, relate to the visitor's life, require visitor involvement, and illustrate concepts that are also part of a larger idea (Veverka, 1994). This sentiment is echoed by Sue Allen through her inquiry cycle of surprising phenomenon, exploration, explanation, and relevance (2003, S19). This cycle begins with a concept that compels the visitor. Exploration occurs when visitors experiment with the interpretive exhibit. The explanation is discovered after reading the label and one determines its relevance by relating it to his or her own life.

Every exhibit must have a form, whether it is more traditional and conservative or new-age and open. This is why it becomes essential to set up a framework which defines criteria that must be met to suit certain goals so that the exhibit may be assessed later by those standards (Serrell, 2006). Regardless of which framework is best, a museum's exhibits must aim to please its visitors. In general, people feel more comfortable in bounded or confined exhibitions. In many cases, visitors feel more grounded in such situations and find their way easier (Leinhardt and Knutson, 2004).The distinction between a “good” exhibit and a “bad” one can be a fine line. When a framework is in place, however, it does not need to be. Good exhibits promote immediate apprehendability, physical interactivity, conceptual coherence, and diversity of learning modes (Allen, 2003). Immediate apprehendability is vital because the informal environment of a museum does not require specialized education in any topic, so all visitors are starting anew. Interacting with an exhibit physically allows for a better grasp of the concepts being taught. It also allows people of varying learning styles to arrive at the same conclusions at their own paces.

There are many different ways to present educational information, some more effective than others. Some of the more effective methods are “user-centered design,” (Allen, 2004, S21) analogy-based exhibits and “exhibits as exemplars of phenomena” (Stocklmayer and Gilbert (2002). These techniques push visitors to learn by relating real-world occurrences. In an exhibit utilizing user-centered design, objects are designed so they may only be used in one specific way, such as a lever, so that all users are able to understand how to interact with the exhibit without reading its label. An exemplar of phenomena “is an idealized example of a real-world phenomenon” that provides a direct experience with the phenomenon through sensory stimuli or detection instruments (Falk & Dierking, 2006, 968). Analogy-based exhibits are based on correlations between the items that make up the exhibit and those which they are supposed to represent from the outside world, branching museum visits to patrons’ lives. This method usually involves a physically interactive simulation that represents a larger concept.

3.5 Museum - School Programs

As the purpose and role of the museum evolves with the changes in society, it has become apparent that strong relations between school curricula and museum exhibits are vital to student learning beyond the classroom. Toward this end, museums are increasing the focus of their exhibits and outreach programs on S.T.E.M. concepts and ideals to reinforce these subjects already being taught in the public and private schools.

3.5.1 S.T.E.M

Science Technology Engineering and Mathematics (STEM), is the basis for many programs and curricula to encourage growth in the aforementioned fields through education. This ideal has been supported by politicians, educators, and organizations such as the National Science Foundation (NSF) and the National Aeronautics Space Administration (NASA) just to name a few. In fact, both organizations grant scholarships to future college students entering into STEM-related fields. STEM has been promoted by both formal educators in this way and informal educators alike. The NSF has a particular branch, the Center for the Advancement of Informal Science Education, which aims to bring STEM to people through various methods of informal education such as community-based efforts, museum exhibits and local groups. Many museums aim to expand upon STEM-related topics as an effort to appear more relevant in an age where science and technology are essential to every day life.

Informal science education aims to reach a wide range of people by using a number of media to illustrate principles of science, technology, engineering, and mathematics. Some of these media include lectures, exhibitions, the internet, television, movies, and literature. Each of these media helps “inform the public about STEM via out-of-school mechanisms” (Falk, Randol, and Dierking, 2008, 2). This method relies heavily on the effort of a diverse group of educators working closely to achieve the goal of bringing STEM to life for others.

3.5.2 Museum Outreach Programs

Over the years science museums and centers developed “a shared mission to open the public's mind to science and technology - especially young minds, in ways complementary to their formal education - the hallmark of science centers became the interactive exhibit” (Koster, 1999, 277). By blurring the borders with other educational institutions through the use of outreach programs a wide variety of subject matter became more accessible to people of all ages. “When the centers [museums] and the school districts work together to develop inquiry based learning opportunities linked to the school curriculum, the window of opportunity for making students' learning more meaningful, more connected and therefore more permanent, opens wider" (McLeod & Kilpatrick, 2002, 62).

Outreach programs are provided by all types of museums including aquariums, art, science and history museums, and even zoos. Museums began to hold live demonstrations, both in the museum and on the road, and even began to work together to coordinate large touring exhibitions (Koster, E.H., 1999). These demonstrations created a means for museums to support and enrich school curricula, presenting an engaging experience for all.

The Museum of Science Boston offers a large assortment of programs for children grades K-8 and groups of various sizes. One program created for kindergarteners to second graders is titled "Animal Habitats" and allows students to learn about the habitats of three live animals that the museum brings to the school. Students have the opportunity to "observe and look for clues that determine [the animal's] ideal shelter and food" (Museum of Science Boston, 2008, 4), and use the acquired information to assign a habitat for each animal. The program also presents students with "assorted skins, bones, and feathers to actually 'feel' some of the characteristics that help [the] animals survive" (Museum of Science Boston, 2008, 4).

A second program entitled STARLAB Portable Planetarium is a fifty minute program in which a portable dome is used to help students recognize patterns in the night sky, identify constellations and learn how astronomers find individual stars by looking at the surrounding constellations (Museum of Science Boston, 2008). Other topics presented by the Museum of Science Boston include, but are not limited to: Motion: Speed, Velocity and Acceleration, Electromagnetism, Weather: Wind, Water and Temperature, and Cryogenics: States of Matter.

3.6 Conclusion

The process of creating and updating existing museum exhibits can be an overwhelming task. It involves understanding the types of learning that occur in museums, principles of exhibit and program design, educational guidelines and the capabilities of the sponsor museum. By grasping these basic concepts, this project group was able to develop a comprehensive methodology that allowed us to gain valuable data from which detailed recommendations to the MMA were made.

4. Methodology

The overall goal of this project was to assist the MMA in exploring ways to update the exhibits in the Natural Science Museum to encourage school group visitation. To achieve this goal agreed upon by the MMA, we reviewed literature on museums, contemporary exhibit design and learning styles. We conducted interviews with our sponsors Dr. Janet Schulte and Dr. Bob Kennedy, as well as the MMA staff, to determine what changes might be made to improve the existing exhibits. We also held a free public open house on November 8^{th} to observe how children interacted with the current museum exhibits. We interviewed teachers of our target audience from Nantucket Elementary School and the private schools on the island to determine what they believe needs to be done to the natural science exhibits in order for them to bring their classes to the museum. We used the data obtained from these interviews and observations to determine which exhibit displays to update and create ideas for our prototypes. These prototypes were tested by eight groups of K-5 students from the Lighthouse School, Nantucket Elementary School, Nantucket New School, and the Boys and Girls Club who were invited to the Hinchman House for field trips during our stay on the island. We observed these groups interacting with our prototypes which enabled us to learn which features are most attractive and interesting, modify them appropriately, and make the best recommendations possible to the MMA.

4.1 Objective 1: Updating the Natural Science Exhibits

In order for us to update the current exhibits in the MMA's natural science museum we had to first evaluate the effectiveness of the current exhibits. Once we had determined which exhibits to improve, we created several prototypes based on bird adaptations and erosion. We then evaluated and modified the prototypes based on observations made during the special school trips to the museum and the responses obtained from the children through small activity packets and end surveys. The following sections describe the processes that we took to gather the necessary data to create, evaluate, and modify our prototypes.

4.1.1 Determine the Effectiveness of the Current Exhibits

The first thing that we needed to do when we arrived on Nantucket was to evaluate the effectiveness of the current exhibits in the MMA's Hinchman House. In order to accomplish this goal we first conducted interviews with our sponsors and the rest of the MMA staff to establish their opinions of the current exhibits and what should be in the future updated museum. With the help of the Public Relations Coordinator, we were able to successfully advertise and hold a free public open house on Saturday November 8th. The last to step we took was to hand out feedback surveys to the visitors of the open house. These surveys allowed us to determine the visitors', both young and old, opinions of the current museum and what they would like to see in the future.

4.1.1.1 Interviews

Interviews were the first step in our evaluation process of the Hinchman House at the Maria Mitchell Association. During our first two weeks on the island we interviewed nine MMA staff members, including our sponsors Dr. Janet Schulte and Dr. Bob Kennedy, in order to understand what the museum is to its staff, whether they feel it is reaching the people it is meant to serve, and what could be done to improve it. The notes from these interviews are given in Appendices C-5 to C-10. We began by interviewing our sponsors: Dr. Janet Schulte and Dr. Bob Kennedy. They provided us with good background information about the museum itself as well as many suggestions. From there, we interviewed other staff members including the Public Relations Coordinator Rachel Rasfeld, Director of Education Darcie Vallant, possible future director of the museum and black widow researcher Cheryl Beaton, the Children's Program Instructor Marjorie Thomas, the resident librarian and historian Jascin Finger, as well as, the Astronomy Department staff Vladimir Strelnitski and Gary Walker. Each of these people provided different opinions of the Hinchman House due to their varying backgrounds and specialties. Although their ideas each differed, the staff all felt that the current natural science exhibits were ineffective learning tools by themselves.

For our interviews we used a semi-structured style, which allowed us to prepare a list of questions that were more open-ended than structured to guide us through the interview. All three of us were present for each of the interviews. Victoria filled the roll as the lead interviewer, while Molly assisted her by occasionally helping to refocus the interview. Both interviewers took notes. Alex typically remained silent during the interviews and took notes. This method of interviewing allowed us to acquire the most accurate and descriptive notes possible. Since all three group members were taking notes the likelihood that a comment was missed was greatly minimized.

4.1.1.2 Open House

In order to evaluate the current exhibits we had to develop a way for people to come to the museum which is typically closed during the off season. With help from the MMA's public relations coordinator, we held a free Open House on Saturday, November 8th from noon to four PM. To advertise for this event, fliers were posted at local gathering places in town and sent home with elementary school children. The event was also listed on the MMA's website, www.mmo.org, and in the *E-comet* monthly newsletter approximately two weeks in advance.

During the Open House community members were allowed to look around the museum as they pleased. As a group we decided to refrain from incorporating the staff member led tours that had become a standard procedure over the years. This allowed us to observe visitors as they interacted with the exhibits in their most basic form and from the resulting data, determine their effectiveness. To guide visitors in a general direction of movement through the museum, we placed yellow deer hoof prints on the floor, as seen in Figure 1 below.

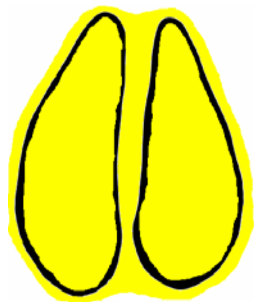

Figure 1: Open House Deer Track

It was our hope that this would decrease congestion and make for easier data collection since everyone would be moving in the same direction. Deer tracks were chosen because of the large deer population frequently mentioned on the island. We had hoped that an easily recognizable image would allow people to know which way to walk. The following figure, Figure 2: Floor Plan of Open House Observations, shows the path of the prints in yellow which started near the gift shop and ended at the doorway.

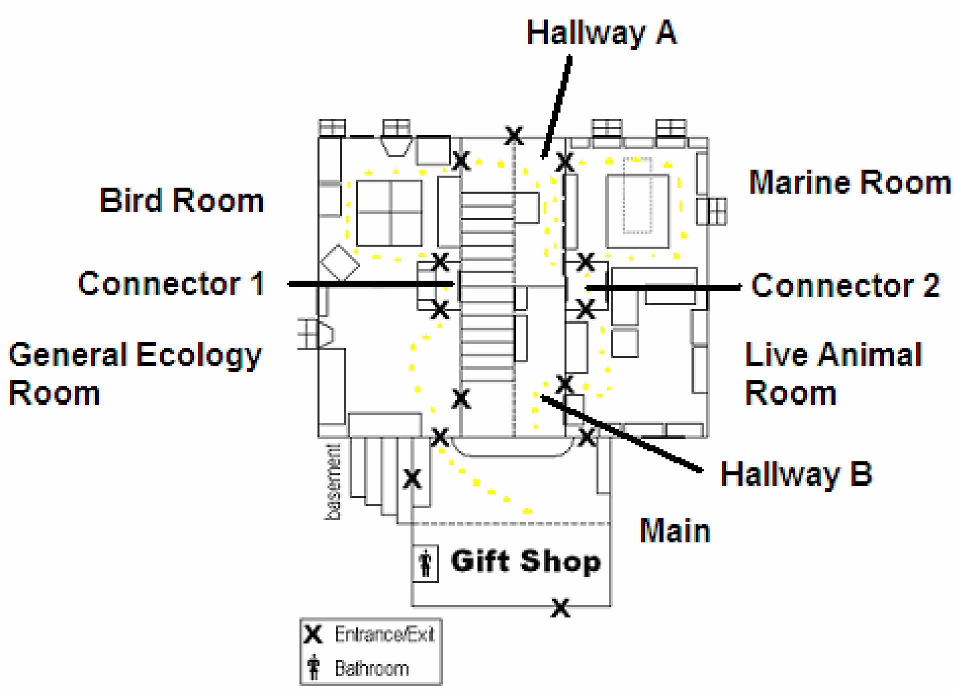

Figure 2: Floor Plan of Open House Observations

Throughout the four hour period that the museum was open, visitors came and went in small waves. According to Rachel Rasfeld, these visitors were an accurate representation of the number of visitors received during a typical summer day. As people entered the museum they were greeted by

Victoria who informed them of our project and the end survey. When parents and their children entered she explained the project in further detail and asked them to fill out the informed consent form, located in Appendix J, clarifying when necessary.

Of all the visitors that came to the open house, we only observed how the children interacted with the exhibits since our target audience was the kindergarten to fifth grade age group. To observe the children, we used the check list given in Appendix F-1. In addition to greeting everyone, Victoria, also observed the exhibits in the Main room. Molly observed the exhibits in the General Ecology room, the small connector referred to as Connector 1 and the section of hallway labeled Hallway B in Figure 2: above. Marjorie Thomas' husband, Dan, volunteered to help us observe the visitors in the Bird room while Alex oversaw Hallway A, the Marine room and the connector referred to as Connector 2. During our observations we focused on how the children interacted with the exhibits in each of the rooms. Our two main categories for observation were glanced at, in which the visitor stopped, looked at the exhibits for a few moments, and possibly went on to do further interactions or ignored, where the visitor did not stop to look at the exhibit.

4.1.1.3 Feedback surveys

At the end of the visits, Victoria asked all of the visitors to fill out a short end survey which is shown in Appendix D-1. By asking all of the visitors to complete the end survey, we were able to establish the adults' opinions of the museum and try to make the prototypes appealing to all ages. Typically the parents with young children asked for the child's input before they answered the questions and in a few instances the older children filled out their own surveys.

These surveys were tested on other IQP students in Nantucket. These tests allowed us to assess the clarity of language, ease in which the respondent can answer the survey and the difficulty in evaluating the responses (Fink, 1995, 2006). The pilot test group consisted of the four WPI undergraduates and was administered on a volunteer basis during an evening after the surveys had been drafted.

4.1.2 Prototypes

To determine the lessons that our prototypes presented, we compared the data from: the open house end surveys, the interviews with the MMA staff, the Massachusetts Science and Technology/Engineering Curriculum Frameworks and the interviews with the public and private school teachers that we conducted for Objective 2: Increasing School Visitation to the Hinchman House. We looked for subjects that were continuously mentioned in the above data sources. Then we determined if the subjects were presented in the current exhibits and, if so, reviewed our open house observation data to determine if the subject was in one of the exhibits that attracted the least attention. Once we determined the topics we wanted to present from the above data, we tried to come up with creative ways to make the lessons interactive with the very simple materials: paper, tape, and house items, that we had on hand.

4.1.2.1 Erosion Book

Creating an erosion prototype proved to be a bit challenging. We wanted to create a prototype that was appealing to our target audience, interactive and preferably hands on. Given our short stay on the island we felt that we did not have enough time or resources to build an erosion display that incorporated water and sand, to show how the water physically moves the sand off the beach. Dr. Bob Kennedy informed of a program run by Williams-Mystic that used to visit the island. Every year the students involved would take a picture of themselves holding hands from a specific building to a costal cliffs. Over the years the number of people required to reach the cliffs decreased because of the erosion. The concept of these pictures and a talk with Marjorie produced the idea of the prototype book.

Using easily accessible material including rubber cement and construction paper, we created a seven page book on erosion. The first page of the first version of our prototype is given in Figure 3 on the next page.

Figure 3: Erosion Book Page 1, Version 1

With the turn of each page a person would disappear from the land as part of the cliff was washed away by the waves. The book talked about what erosion is and the different factors that cause it, such as waves and wind.

4.1.2.2 Bird Beak Adaptation

The Bird Beak Adaptation prototypes consisted of a group of three comparison based displays which focused on the beak adaptations of four specific types of birds: sand pipers, ducks, wood peckers and nut cracking beaks. These prototypes were based on an exhibit located at the Museum Of Science Boston which also compared animal features to household tools. The sand piper display used two sets of tweezers, one long pair and one short pair to show how the different beak lengths that various types of sand pipers have allow them to get at food (rocks) located at different depths in a container of sand. The duck beak/bill display compared the ducks lamella to the baleen of a whale and allowed visitors to use a comb to sift the rocks out of a container of sand. The wood pecker display used a dulled nail to represent the hard short beak of the bird. Visitors were allowed to peck at a piece of log and compare the nail to their finger and determine which was better at getting under the bark. Our sponsor felt that this prototype was too dangerous. As a result it was replaced by a nut cracking beaks display. This display used a pair of pliers and a set of tweezers to crack sunflower seeds. Visitors were able to determine which tool or beak type was better for breaking the seeds. In the following image, Figure 4, the first versions of the sand piper (far left) wood pecker (center left) and duck beak (center right) and nut cracking (far right) prototypes are shown.

Figure 4: Bird Beak Adaptation Prototypes

4.1.2.3 Bird Feet Adaptation

The third prototype built was also a comparison based exhibit about the adaptation of bird feet and claws. This prototype was created for the same reasons as the bird beak exhibit. For this exhibit, we used the same process of creating analogies to illustrate how different varieties of bird feet or claws are better suited for different habitats. The two adaptations featured were webbed feet and clawed feet. To represent habitats, such as wetlands and land areas where these adaptations exist we used a Tupperware container filled with water and a stick perch, created by taping branches together in a T-shape with masking tape. The two bird foot adaptations were made from household items. A spatula was used to represent the webbed foot because of its large surface area while a staple remover was used to represent a clawed foot since it was easily able to grab onto the perch. This prototype was set up on a table in two parts show below in Figure 5.

Figure 5: Bird Feet Adaptation Prototype

The perch and the container of water were set up side by side but clearly separated. The “feet” were each laid out in front of both “habitats” so that the water container had a spatula and a staple remover in front of it and the perch did as well. The intention was to allow visitors to try both “adaptations” in either setting to determine which one works best for its respective “habitat.”

4.1.2.4 Evaluation

To evaluate the prototypes, we invited kindergarten through fifth grade classes from the Lighthouse School, Nantucket Elementary School and the Nantucket New School to visit the museum. During the field trips the students were given a tour by Cheryl Beaton. During these tours we made general observations about how the children acted, primarily if they were attracted to the exhibits before they were allowed to look around. After talking briefly in each room she allowed the children to look at the exhibits, it was during this time that we made the majority of our observations. This observation sheet is given in Appendix F-2.The adaptation prototypes were placed in the bird room while the erosion book was placed in the marine room. Since we received information about the existing exhibits during the open house, we concentrated our attention solely on the interactions between visitors and the prototypes. We observed the interactions much like we did during the open house, but this time each of us focused on one exhibit instead of a whole roomful. During the eight field trips: Alex observed the bird beak prototype, Victoria observed the bird feet prototype and Molly observed the Erosion Book prototype. During the visits with the lower grades, primarily kindergarten to second grade, we had to tell the children about the exhibits and explain what to do since they were just beginning to learn to read. When the older children visited the museum, we let them interact with the prototypes as they pleased; however, if they asked us a question that was answered in the text, we redirected them to the prototype labels.

At the end of the tour the children were given small activity packets, located in Appendices D-5 and D-6, to fill out. These packets contained basic questions about the prototypes and their analogies, as well as, some of topics mentioned on the tour. We used the responses to these questions to determine if the children were able to learn the lesson in the exhibits. Once they filled out the activity packet they were asked to fill out a brief survey, given in Appendices D-2 to D-4, about their opinions of the prototypes and the museum. We also told the children to leave a question blank or draw a question mark if they did not know the answer. For this activity it was ok to not know the correct answer.

We then analyzed the data from the two questionnaires to gauge the prototypes. Answers were broken down into four categories, correct, wrong, partially correct, and blank. By looking at the number of correct answers we could tell if the prototypes were successful. We also looked at the partially correct answers to determine what part of the prototype they did not understand. For example, some of the children understood the analogy in the adaptation prototypes, but not how it related to the bird. For the blank answers we took in to consideration how much time the children had to fill in the questionnaires since a few of the visits ran late and they did not have a much time to fill in the answers as they may have needed. In our evaluation process we interpreted the blanks and question marks to signify that the children did not know the answer to the question. Once we determined what categories the answers fell in we looked to see if the answer was given in the text description. After we analyzed the results from the questionnaires, we looked at our observations and compared the data to see what needed to be changed before the next class came to visit. For example if lots of children answered a prototype question wrong or left it blank, we tried to make the text easier and shorter to encourage the children to read. Changes to the prototypes were also made based on our observations. After the first groups of children came from the light house school, we noticed that the children were jamming the pliers down to the bottom of the sand piper display which defeated the purpose of the exhibit. As a result we replaced the pliers with a very short pair of tweezers.

4.2 Objective 2: Increasing School Visitation to the Hinchman House

The main source of our data for this objective came from Nantucket teachers. As a result one of the first tasks was to obtain any teacher contact information that the MMA already possessed. We then scheduled interviews with teachers from the Nantucket Elementary School, Lighthouse School and the Nantucket New School. The following sections describe the methods used to determine the kindergarten through fifth grade curriculum, as well as, the topics discussed with Nantucket teachers to determine how to increase school visitation to the Hinchman House.

4.2.1 Determine Curriculum of Target Audience

To determine the curriculum of the kindergarten to fifth grade classes of the Nantucket Schools we began by reviewing the Massachusetts Science and Technology/Engineering Curriculum Framework. These frameworks for kindergarten through fifth grade are given in Appendix K. We then looked at the current exhibits to see which frameworks were present in the current museum.

We also interviewed the one second grade and three fifth grade teachers from Nantucket Elementary School, and one seventh and eighth grade Nantucket New School science teacher. The general questions for these interviews are given in Appendix B-6. For these interviews we used a digital audio recorder after we were granted permission by the interviewee. We used the same interview style as with our sponsor and MMA staff interviews. Victoria acted as the main interviewer, while Molly was the secondary interviewer and Alex took notes. We also met with five, kindergarten through fifth grade, teachers from the Lighthouse School during a teacher meeting. This meeting was not recorded because of the large number of people present. There were too many people for us to get decent sound quality with our recorder. The notes from this meeting are given in Appendix C-14. One teacher from the Nantucket New School also filled out a questionnaire after her class visited the museum since we were unable to set up a meeting. We asked these teacher questions about their current curriculum and how they determine what frameworks are covered in a specific grade.

4.2.2 Determine Why Classes Are Not Visiting the Hinchman House

In order to determine why teachers are not taking their classes to the Hinchman House for field trips, we met or gave a questionnaire to the same eleven teachers mentioned above. We asked the teachers about the previous dealings with the MMA, and their opinions of the Hinchman House exhibits, if they knew about it. We also asked them if they were interested in bring their classes to the Hinchman House, and what topics they would like to see in the museum. Other questions pertained to the feasibility of trips to the museum, and the obstacles that teachers face when trying to get their classes out of the classroom.

5. Results and Analyses

Over a five week period, data was collected on the natural science exhibits in the Hinchman House. The data was collected during a free Open House and several school field trips to the museum. During the visits to the Hinchman House we aimed to determine how the children interacted with the current exhibits and our prototypes, and if they were able to retain any of the information presented. We also provided end surveys to willing visitors to obtain their opinions of the exhibits. Simultaneously we interviewed numerous MMA staff, as well as, public and private teachers to determine their opinions of the Hinchman house. By combining observational, survey and interview data, we were able to understand the current exhibit's teaching ability. In the sections below we will discuss the relevant data that pertains to our two objectives. We will discuss the effectiveness of the current natural science museum, as well as explain how we created our prototypes and modified them based on our evaluations. We will also explain the curriculum of the target audience, its presence in the Hinchman House and why teachers are not bringing their students to the MMA.

5.1 Objective 1: Updating the Natural Science Exhibits

5.1.1 Determine the Effectiveness of the Current Exhibits

To establish the effectiveness of the current exhibits in the MMA's natural science museum we created three tasks that needed to be done. First we interviewed the MMA staff to obtain their opinions of the current museum and what they believed should and should not be incorporated into the updated exhibits. We then held a free public open house on November 8th so that we could observe children interacting with the current exhibits on their own. The final step was to give an end feedback survey to the visitors, both young and old, of the open house. This survey helped us understand what their opinions of the museum were, as well as, what topics and exhibits they would like to see in the future museum. The following sections describe in detail the result obtained from the interviews, open house and feedback surveys, in addition to how we determined the topics for our prototypes.

5.1.1.1 Staff Interviews

In order to further understand what the opinions were of the current museum exhibits, we conducted a multitude of interviews with various staff members of the MMA. Among those interviewed were both our sponsors, Dr. Bob Kennedy and Dr. Janet Schulte, as well as the Director of Education, Darcie Vallant, the Director of Astronomy, Vladimir Strelnitski, and Gary Walker who works with Vladimir in the observatory. Our last formal interview with a staff member was with Jascin Finger, who is the curator of the Maria Mitchell House. We also met with Cheryl Beaton, Marjorie Thomas, and Rachael Rasfeld, although we did not have formal interviews with these members since we saw them on such a regular basis. Unlike our interviews with the teachers, we did not feel the need to record our meetings with the MMA staff, since we could always meet again if we needed clarification.

As can be expected, it was generally thought that the exhibits as they were in need of renovations and updates. Specifically, Dr. Schulte voiced that she would like to see exhibits that used more senses other than sight. Some examples that she gave were the possible implementation of bird calls in the bird room, and an increase in interactive exhibits in general. This idea was echoed by Darcie, Cheryl, Marjorie, and Rachael, and was one of the concerns we hoped to address while on the island. In our interview with Dr. Kennedy, who is a specialist in geology and birds, he suggested that the museum have exhibits regarding the effects of global warming on Nantucket. During the interview he made it clear that, to him, the Natural Science Museum should focus only on that which can relate to the island and those who inhabit it. Other MMA staff believes it as a place where visitors can come in and learn how to become an amateur naturalist, by learning all about the diverse life forms that live on Nantucket. In our interview with her Dr. Schulte also voiced a wish to bring in more school groups from the island, especially since the school months are typically when the MMA closes the Hinchman House for the season. To do this she expressed the need for future exhibits to relate more closely to the curricula of local schools.

To accomplish this we set up our interview with Darcie explaining our need to talk to local teachers and interview them regarding their current curricula. During our interview with Darcie, we received a list of contact information for various teachers that she had been in contact with before. She also gave us valuable information such as how much lead time we should allow for teachers to respond to our inquiries, what kind of responses we can expect from certain schools, and that the demographics of the home schooled children on the island are too young for our study's purposes. This interview saved us huge amounts of time, especially with finding contact information for the local schools.

Our interview with Vladimir and Gary was interesting, in that their enthusiasm for astronomy and what they do was clearly evident. Their suggestions would be difficult to tie them into the rest of the museum. One such suggestion was to have an ongoing mural around the walls of the room that showed the evolution of life on earth, from the Big Bang, to present day. Among their inventive advice, there were some suggestions that we did use when creating our prototypes. One of these was to pose more questions to the visitor and thus involve them more intellectually in an exhibit. Rather than tell the facts to the visitor, they suggested that the museum present arguments and data that allows the visitor to figure it out for themselves. We felt this was a great way to transform an old exhibit to a more interactive one, without having to redo the entire way it is taught. Another great idea was to utilize the ceiling space of the museum more. Due to the space limitations presented in the museum, making use of ceiling space as a place to display various birds soaring overhead, or large model insects would provide stunning visuals for visitors to enjoy. As it is, only one room utilizes the ceiling as a place to hang a dolphin skeleton. Despite our later findings that most children tend not to look at exhibits much higher than their eye-level, we did notice that plenty of visitors paid attention to this exhibit.

Another interview that proved interesting was with Jascin Finger, the MMA curator. We feel that our interview with her was representative of a certain portion of the island population which is resistant to change on the island. As we heard from some visitors to the open house, as well as from Cheryl, the museum hasn't changed its contents in nearly 50 years, and that's just how some people like it. Jascin was of the opinion that, although the museum needs some updates to its exhibits, the overall feel of the old museum style should not change. She advised against making too many radical changes to the museum as it might drive away the older audiences who come here because it offers something familiar from their childhood. She also did not like the idea of incorporating more technology into the museum for she felt it might be too loud, overwhelming, and too distracting to other visitors.

We used this information as well as that collected in the open house and teacher interviews to come up with prototypes that added something new to the museum while still tying in nicely to the already existing exhibits.

5.1.1.2 Open House

Over the four hour period of the Open House there was a total of 38 visitors whose demographic breakdown is shown in the graph below.

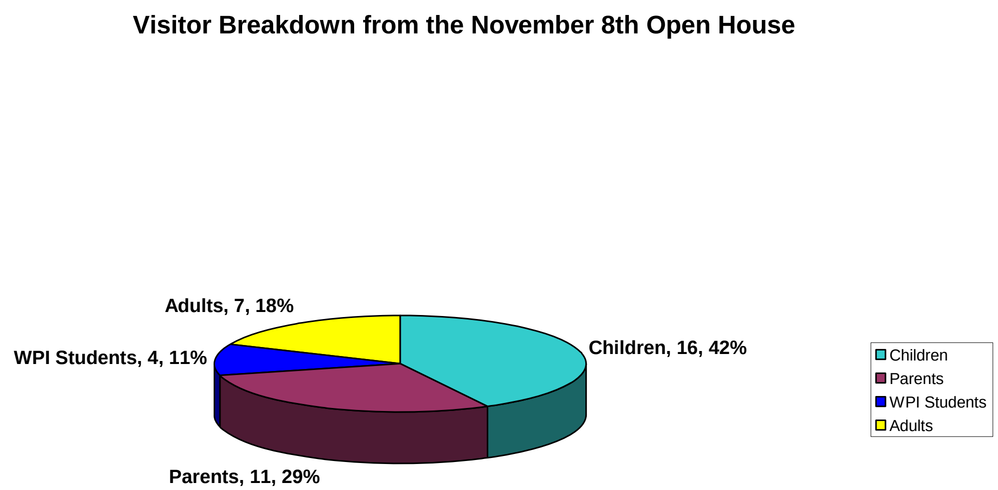

Figure 6: Visitor Breakdown from the November 8th Open House

Of the thirty-eight visitors, twenty-one filled out feedback surveys yielding a 55% response rate. Of the visitors that filled out the surveys, eleven were dispersed throughout our target audience, of kindergarten to fifth grades, while eleven were not. This can be seen in the Figure 7 below.

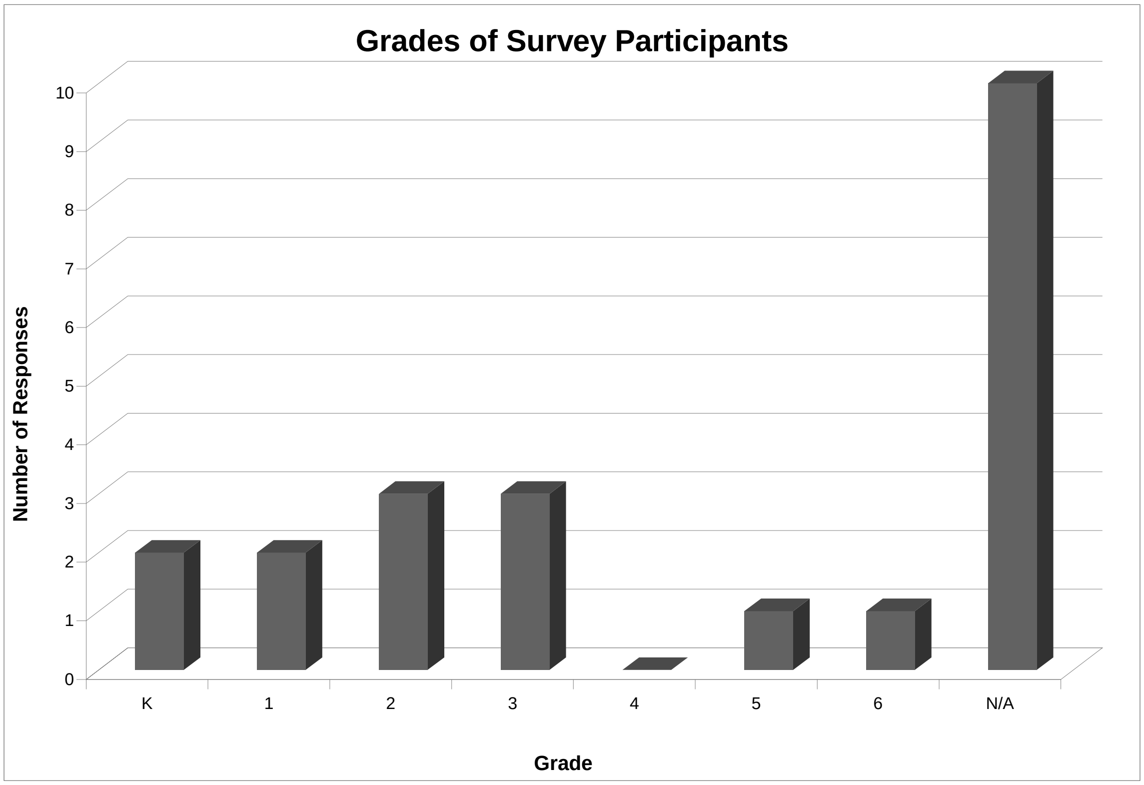

Figure 7: Grades of Survey Participants

5.1.1.2.1 Observations

Some observations that we made were concerning our incorporation of the deer track path in the museum. The path succeeded, given that many of the visitors were able to follow the path through the museum in the right direction. Unfortunately many visitors, adults and children, did not know the difference between the front and the back of a deer print which caused some confusion. This resulted in visitors traveling through the museum in the opposite direction that the majority of people were traveling. Also some of the child visitors insisted on following the path from beginning to end without even a glance at the exhibits. Only after they had reached the end would these children return to the entrance of the museum to examine the exhibits.

5.1.1.2.1.1 Main Room

Our observations show that many of the children ignored most of the exhibits. In the Main Room, as shown in the figure below, most of the exhibits were ignored.

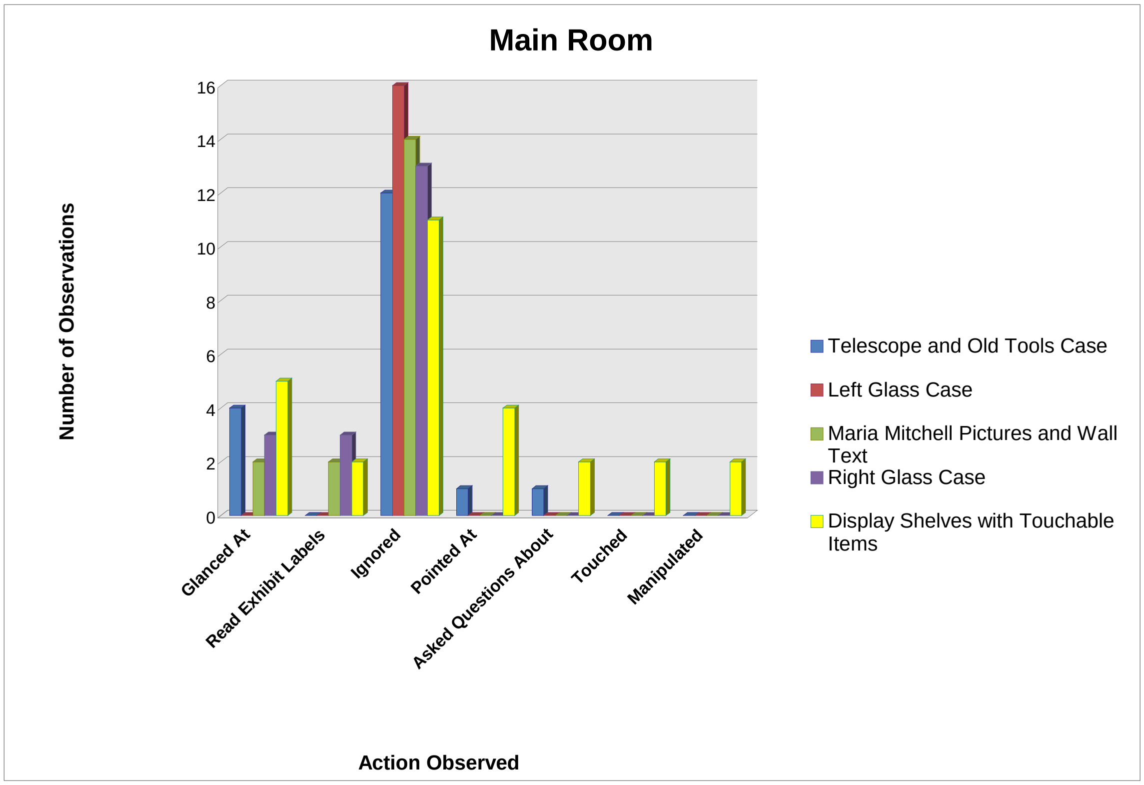

Figure 8: Main Room Open House Observations

The exhibits that received the most attention were the display shelves with touchable items and the telescope and old navigation tools case. These two exhibits attracted more attention than the other exhibits. The display shelves with touchable items provide a hands-on experience for the children and are one of the few exhibits that can actually be touched. During the Open House five of the children glanced at the exhibit, four of the five pointed at it and two actually stopped to touch, read, manipulate and ask questions about the items displayed. These actions provided stimulation to more than just the children's visual and auditory senses which helps enhance informal learning, and interactive learning. These styles of learning both Falk & Dierking (2000), and Sue Allen (2004) believe should be abundant in museums. The telescope and old navigational tools exhibit attracted attention because they were openly displayed and easily observed since they were located next to the door to the general ecology room. This exhibit showcases old technology which many of the visitors found interesting and were able to relate to their lives since they live in an area strongly tied to the sea. As Veverka (1994) said exhibits that relate to the visitor's life are more interesting and attract more attention.

The other exhibits in the main room were mostly ignored by visitors, since no one stopped to look at them. The exhibits showcase Maria Mitchell and her relatives. They contain small pictures and large paragraphs of text in a small font. As informed by Betsy Loring from the EcoTarium, when creating exhibits text should be large and short to maintain the visitor's attention. These exhibits are not attractive. They do not stand out or draw visitors to them. They have vague ties to the old navigation tools since Maria Mitchell was an astronomer and calibrated similar tools in her youth; however, the exhibits are completely unrelated to the touchable display shelves. This lack of a clear connection between the exhibits present and the large spatial arrangement between the displays in the main room do not provide a museum atmosphere for the visitors. Instead visitors feel as though they are still in the gift shop. These factors caused the main room to be mostly ignored by visitors during the open house. Most visitors just walked right through it, as if it were not part of the museum.

5.1.1.2.1.2 General Ecology Room

Many of the exhibits in the general ecology room were also ignored by the children during the Open House; however, some of the exhibits did attract the attention of the children. The exhibits that attracted the most attention were the collections display and the small mammals of Nantucket display as seen in the figure below. Thirteen

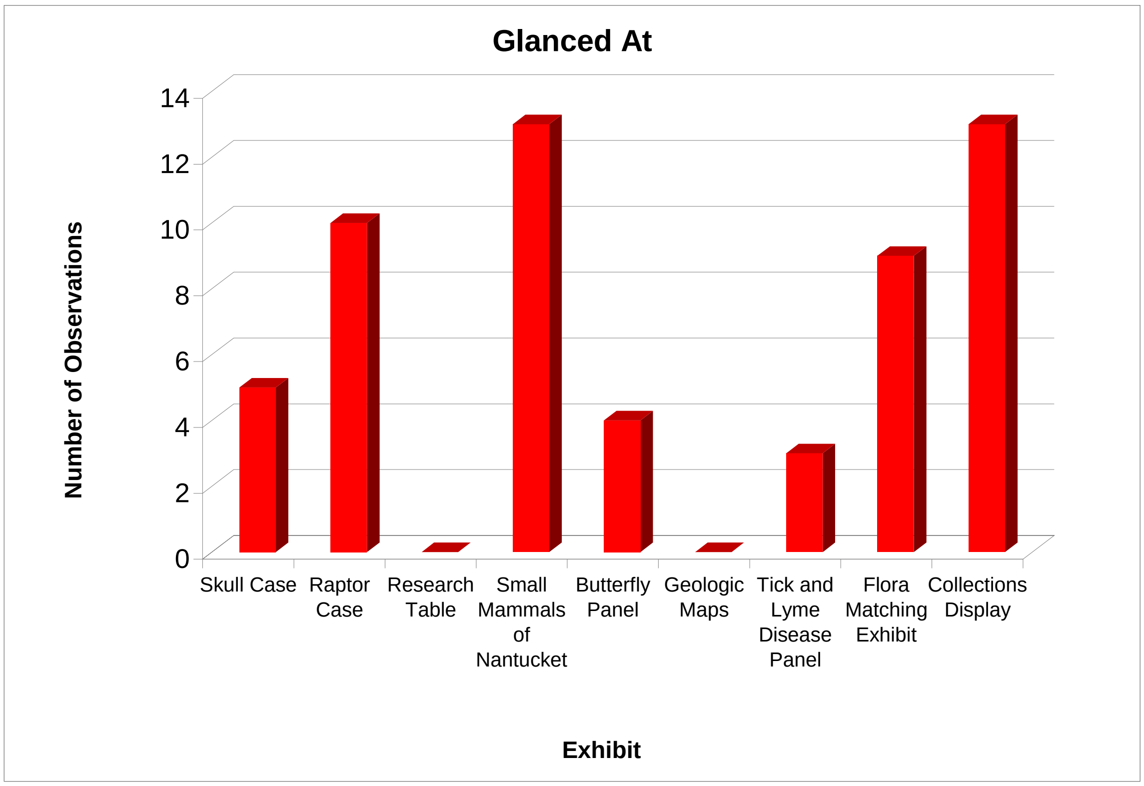

Figure 9: General Ecology Room Open House Glanced At Observations

children glanced at each of these exhibits which included representative animals, and short text descriptions. The raptor case and the flora matching exhibit were also glanced at by over half of the children visitors. The flora matching exhibit provided a hands-on experience for the children; however, the directions were not easily visible to the children. As a result only five of the nine children tried to manipulate the exhibit. It was observed that the lack of directions caused the children to be confused about how to operate the exhibit and parents were needed to explain what was supposed to be done. The three representative birds in the raptor case provided a visibly interesting exhibit. As mentioned by Veverka (1994) interesting exhibits are must in a museum. They spark the visitor’s curiosity and compel the visitors to explore the rest of the exhibits. Sue Allen (2003) describes these actions as the first two steps in her inquiry cycle of surprising phenomenon. The third step, relevance however, is poorly achieved in this exhibit. Upon glancing at the exhibit, only three children continued to read the exhibit labels and only one child asked questions about the exhibit. This is most likely a product of the poor labeling in the case. Most of the text is very small on a poster partly hidden by the animals. The only large text in the case is located on three pieces of construction paper identifying the animals in the display.

The rest of the exhibits in the general ecology room were not glanced at by over half of the children visitors to the Open House. These exhibits all have poor labeling for children. The Butterfly and Tick and Lyme disease panels are both located high on the walls of the room where children can not see them. The butterfly panel showcases many species of butterflies in North America. The pictures of each species are very small and many look identical before a closer inspection offers more details. The Tick and Lyme disease display includes larger graphics and large paragraphs of scientific text that children in the target audience would not be able to read.

Two of the exhibits were also completely ignored by the children. These exhibits are the research table (which was not set up and operational since all of the prepared slides for the microscope were broken over the summer) and the geology maps. The geology maps, located above the fireplace, are presented in a manner that only geologists can understand. They are presented in a very scientific manner and describe the various stages of the glacier movement that formed the island and Cape Cod. Located on the upper half of the wall, they are completely inaccessible to children, especially since it was observed that the children did not look at exhibits that were above their height level.

5.1.1.2.1.3 Bird Room

The bird room contains a large assortment of various types of bird that live on or pass through Nantucket's skies during the year. Of the eleven exhibits in the bird room

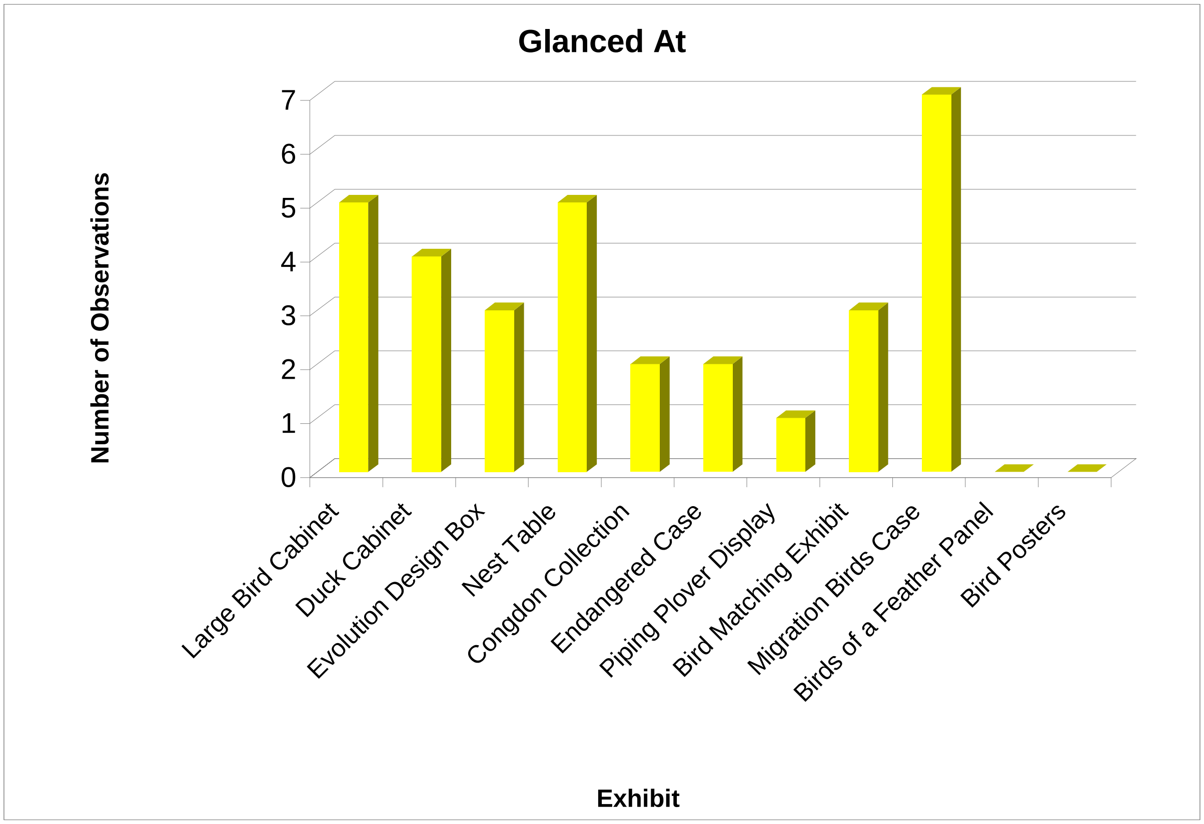

Figure 10: Bird Room Open House Glanced At Observations

only two exhibits were completely ignored by the children. These exhibits were the Birds of a Feather Panel and the Bird Posters which are located above the fireplace where young children can not see them. The last wall panel, the Piping Plover Display, did not receive many glances. In fact only one child looked at the display. The other exhibits that were not "glanced at" by the children were the Endangered Case and the Congdon Display. Both of these exhibits were "glanced at" by two children. The endangered case featured specimens of endangered animals with a sentence long description of the differences between the birds. The exhibit also featured a paragraph long description about the Short-Eared Owl and pamphlets that visitors could take to learn how to protect wildlife on Nantucket. The Congdon Collection presented visitors with sixty-three different species of birds all "perched" on a model tree. Each bird had a number tagged on it which corresponds to an identification list located on the front of the display. This exhibit is not presented in the easily accessible manner that Borun (2008) suggests. Instead this exhibit seemed to overwhelm the visitor with too much stimulation since all the birds are located in such a small area.

The Evolution Design box and the Bird Matching exhibits both attracted the attention of three children. The Evolution Design box identified four different bird skulls and contains a label that has showcases the difference in various bird beaks through the usage of small side-view drawings. Since there is no clear goal to this exhibit the children were not able to immediately apprehend the concept presented, which according to Sue Allen (2003) is one of the key factors in a good exhibit. The Bird Matching display was identical to the flora matching game in the general ecology room; however, for this exhibit children were supposed to match the pictured bird with the correct name. Nine of the sixteen children actually tried to manipulate this interactive exhibit. Since each of the pictured birds matched up with a name the children were able to feel more relaxed trying to play the game since there was a limit to what the bird could be. This boundary exhibit method supports Leinhardt and Knutson (2004) belief that people feel more at ease with defined boundaries in exhibits.

The Large Bird Cabinet, Duck Cabinet, and the Migration Case all glanced at by five or more children. These exhibits are very eye catching and bring everyday objects that the children would usually not see to their level, a concept that Veverka (1994) supports. While this exhibits attracted the attention of the children they did not present the children with any information beyond identification. All of the specimens in these cases are labeled solely with identification tags. This lack of labeling does not help the children learn more detailed information about the birds or the birds that created the nests. As a result only one child read the duck labels, two children read the migration case labels and four children read the large bird case labels. The children were not interested enough to interact with the exhibits further since only three children actually asked questions about the exhibits mentioned.

5.1.1.2.1.4 Marine Room

The marine room was the room the contained most of the exhibits that the children “glanced at”. As shown in the figure below only one of the displays was completely ignored by the children. This was the Sea Birds Cabinet which was located in the corner next to the large whale bones.

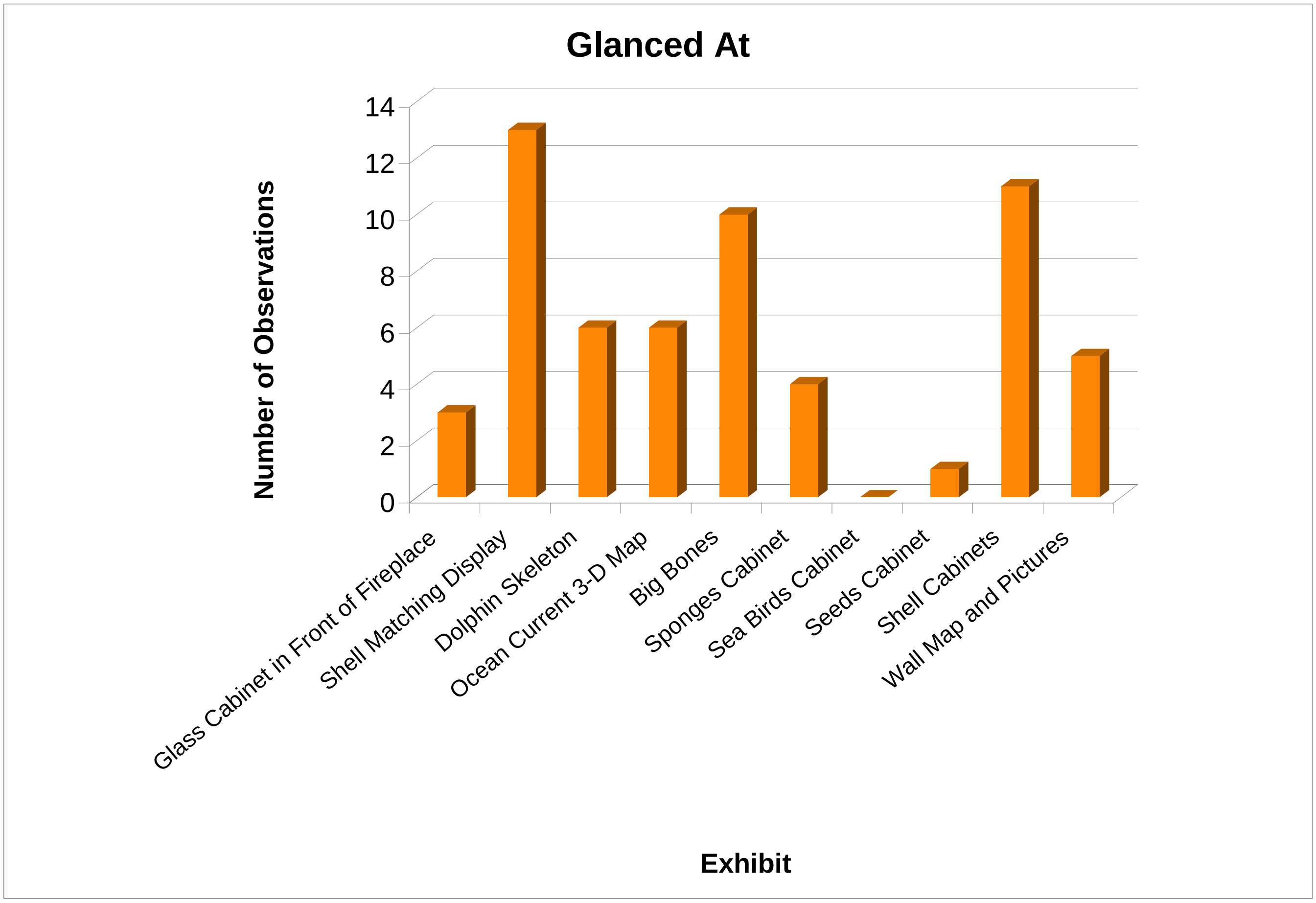

Figure 11: Marine Room Open House Glanced At Observations

The Seeds Cabinet, Wall Map and Pictures, Sponges Cabinet and Glass Cabinet in front of the fire place attracted five or less children. These exhibits all featured a lack of or abundance of text descriptions that are found through out the museum. The labels in these exhibits identified the specimens and provide large paragraphs of description in cramped, small font. Some of these descriptions were also located deep in the shelves where the light does not illuminate them completely.

The Dolphin Skeleton and the Ocean Current 3-D Map were “glanced at” by six children each. These exhibits are located one above the other, since the skeleton in mounted from the ceiling. The skeleton gave children a rare opportunity to see the bones and structure of a bottle-nosed dolphin. While both of these exhibits are interesting to the visitor, only the map exhibit can easily be related to real life. This 3-D bathometric map allowed children to learn and see how the currents around the island are affecting it shape. The children could also see why certain fishing spots are popular as a result of deeper water and why boats stay away from certain areas due to shallow water. In fact every child that stopped to glance at the map also pointed it out to their parents noting where they lived and where their favorite spots around the island were. This easy relation to the children's life is very simple because a large concept, such as the current around the island, had been presented to the children on a much smaller scale. Veverka (1994) supports this presentation strategy while Borun (2008) agrees with the accessibility of the display, since the map could be observed from all four sides.

The three exhibits that appealed to the most children were the Big Bones, Shell Cabinets, and the Shell Matching Game. The Big Bones exhibit attracted the attention of ten children and like the skeleton allowed them to see a part of the whale that they would not be able to see outside of a museum. This exhibit differed from the skeleton; however, since the children were allowed to touch the rib, vertebra and baleen. The shell cabinets drew the attention of eleven children. This contained intact specimen of shells found along the beaches of Nantucket with identification labels. The Shell matching Game presented the twelve children that glanced at it the opportunity to match samples of sea shells and sponges with their correct name. The Big Bones exhibit and the shell matching game appealed to the children's senses by incorporating the sense of touch in the display while both shell exhibits were easily related to the children's beach experiences. Veverka (1994) and Sue Allen (2003) support these types of exhibits which have easy apprehendability, relate to real life experiences and promote physical interactivity.

5.1.1.2.1.5 Connectors 1 and 2

Connectors 1 and 2 are small walk-throughs that connect the general ecology to the bird room and the marine room to the live animal room respectively. These rooms, which contain built-in cabinets and drawers, used to be walk-through closets before the first floor of the house was turned into the natural science museum.

Connector 1 contained three displays: a topographical map of the island, a panel on extinct insects and a display case that contains mounting of insects found on Nantucket. The following figure show how the children behaved towards each of the three displays.

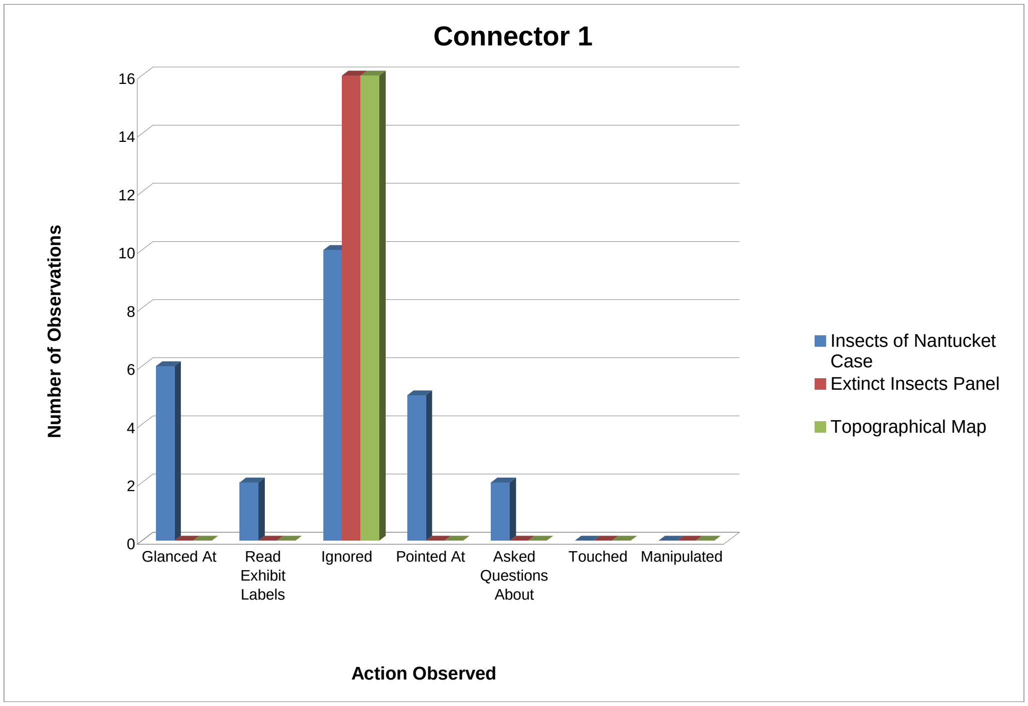

Figure 12: Connector 1 Open House Observations

During the Open House it was observed that all sixteen children ignored the topographical map and the extinct insect panel. This is a result of the exhibits' locations. Both exhibits were located high on the wall well above the children's height, where, as we observed in the other rooms, children do not look. The topographical map also featured a complete lack text so visitors were not able to understand the purpose of the display. The extinct insect display, however, contained a lot of text located in large paragraphs and a small font. The design of this display disagrees with the advice that Betsy Loring gave us. According to her text descriptions should be kept short and to the point while font should be large to make the exhibit easier to read.

The only exhibit in connector 1 that captured the attention of six of the sixteen children was the insects of Nantucket case. This glass sided case is located at floor level and provided easy accessibility for the children to view the specimens inside. As a result five of the children went on to point out features of the display to their parents; however, only two continued to read the exhibit labels and ask questions about the exhibit. These questions pertained to the content of the exhibit since this display also contained a mix of labeled and unlabeled specimens. The exhibits' location also hindered its appeal to the visitors. Since it was located in the connector the rest of the visitors behind the one observing the display were unable to walk into the next room. This sometimes caused congestion with the larger families that came to the open house and it was observed that people quickly moved into the next room to free up the walk-through. This exhibit contained interesting specimens; however, it lacked key attributes that Borun (2008) states are necessities for family-friendly exhibits. This exhibit is not readable, multi-sided, or easily accessible for multiple people.

Connector 2 only contained one display: a poster of the various types of whales. As shown in the following figure, eleven of the sixteen children ignored the poster while five glanced at it. While these five children did stop to look at the exhibit, only one child read the exhibit labels and pointed at it. While this display is located half way up the

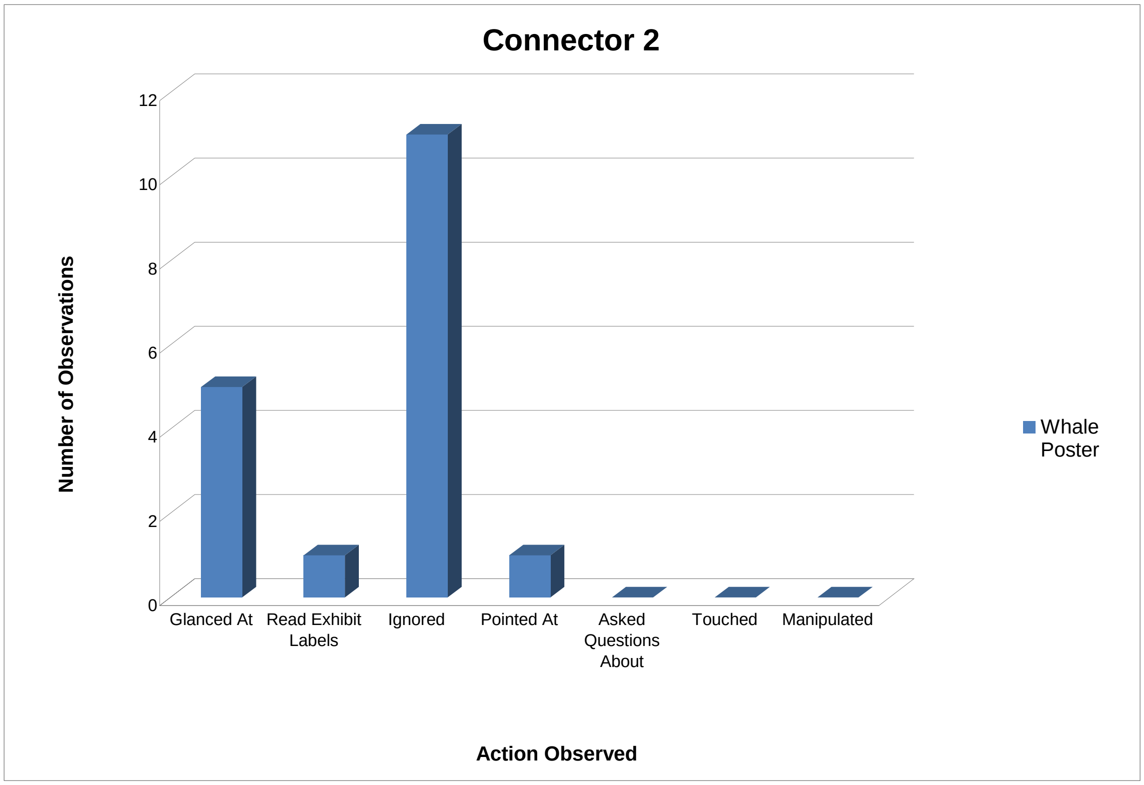

Figure 13: Connector 2 Open House Observations

wall, above where many children looked, it contained very little in the form of text. The exhibit focused on the identification of different types of whales. As a result there is very little visually appealing content other than the image of a whale and its name. This poster provides very little information, interactivity and accessibility in a very small space. These are all features that Serell (2006), Veverka (1994) and Borun (2008) say make up a successful exhibit.

5.1.1.2.1.6 Hallways A and B

Hallway A and B connect the Bird room to the Marine room and the Live Animal Room to the Main room respectively. These sections of the museum are long and narrow with exhibit displays tucked in corners or along one wall.

The exhibits in Hallway A are an algae exhibit, a changes in the land of Nantucket, maps and images, display and some then and now pictures of the island. The following figure shows the observed actions that the children undertook with these exhibits. As mentioned by MMA staff members during the open house, many visitors ignored the displays in this hallway and walked right past them into the Marine room.

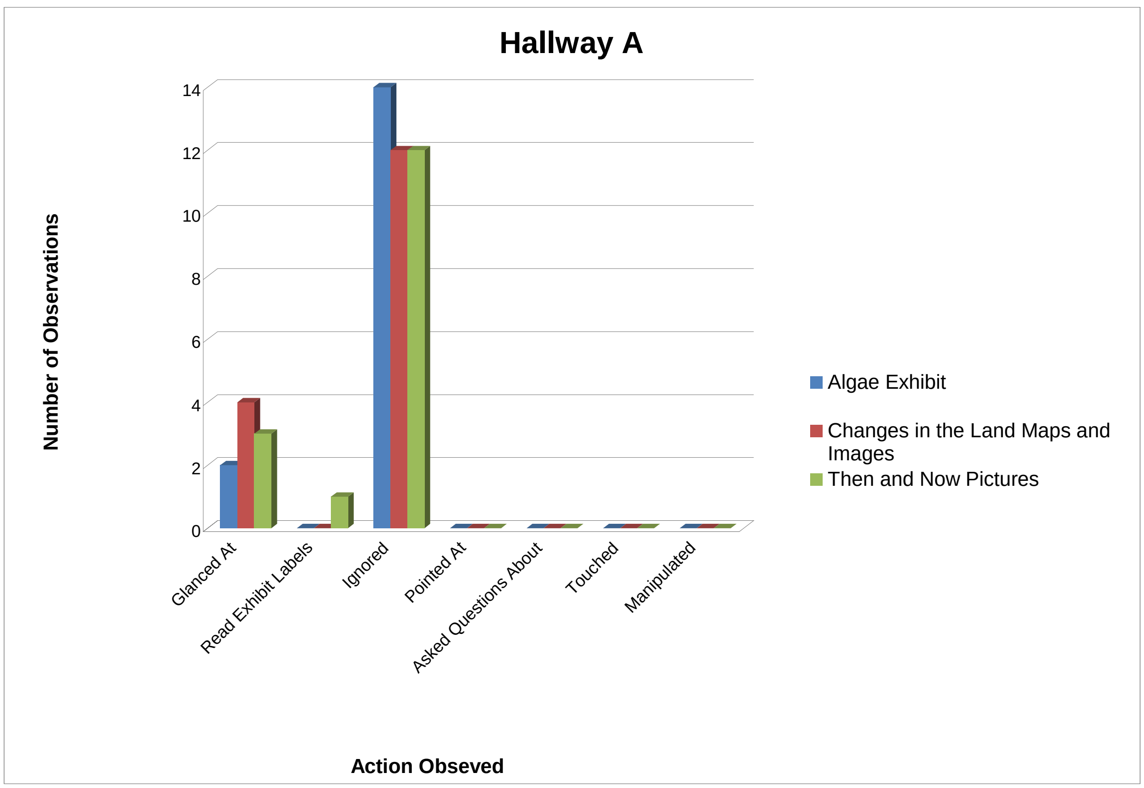

Figure 14: Hallway A Open House Observations

This is a direct result of the building design. Since the doors from the bird room to the hallway and the hallway to the marine room are directly across from each other most visitors do not look down the hallway to see what exhibits are there. As a result the exhibits were ignored by twelve of the children during the Open House; however, each exhibit was glanced at by a few of the children that actually walked by the hall. One child read the exhibit labels of the Then and Now pictures; however, these exhibits contain text descriptions like many of the other exhibits in the museum. The majority of the text was short or nonexistent, not very descriptive and in a small font. The children were not able to interact with any of the exhibits given that they are all wall panels mostly above the children's level or behind glass displays.

The exhibit in Hallway B received a lot more attention than Hallway A. This is due to the Ongoing Research exhibit's location right outside the live animal room door.

As seen in the figure below the just under half of the children visitors glanced at the exhibit which highlights the MMA's research of the American Burying Beetle. Also five

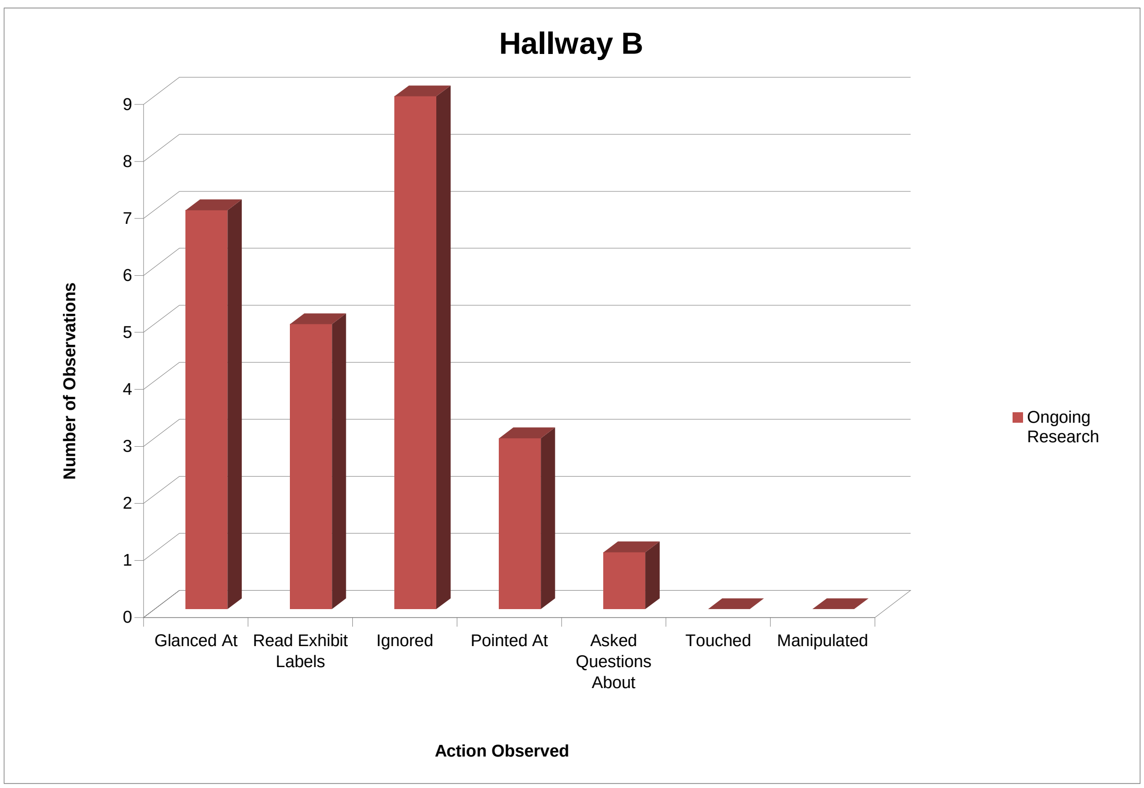

Figure 15: Hallway B Open House Observations

of the seven children continued to read the exhibit labels even though they contain large paragraphs of text. Three children even pointed the exhibit out to their parent and one asked Rachael questions about the beetle. This maybe due to the fact that the American Burring Beetle study is ongoing research. Even though the exhibit features pages of text describing the project, the children stopped to read or skim the text. As Veverka (1994) explained interesting content is necessary for a successful exhibit. The exhibit provides visitors with the opportunity to explore and learn about research that is occurring in their backyard. As Sue Allen (2003, S19) mentions exploration and relation to one's own life are key was in which visitors can explore exhibits. For example, the exhibit features multiple pictures, including a map of Nantucket. This gives children the opportunity to compare the locations where the beetle lives in relation to their home. While this association was not observed at this particular exhibit through interactions between the child and the parent during the Open House, it has been frequently seen in the marine room of the natural science museum.

5.1.1.2.1.7 Live Animal Room

As stated previously many of the staff members believe that the animal room works well in the museum. This is because it is able to draw people in and provides an interactive, hands-on learning environment. The animals showcased in this room give children a chance to relate to their own lives given that they may have seen or found similar animals before in the wild. Since this room is so popular and can get very crowded quickly we decided as a group to not observe the animal room. This decision was made so that we could focus our attention on the other rooms in the museum to make them more attracting. It is our hope that by creating interactive exhibits for the other rooms the children will want to visit the Hinchman House for more than just the "snakes".

5.1.1.2.2 Feedback Surveys

Once the visitors had seen the museum we asked them to fill out the end survey in Appendix D-1. Some of the surveys were filled out multiple times since parents used the same form for multiple children.

Those surveyed generally enjoyed their stay at the museum, as can be seen in Figure 16 below. When asked to measure their enjoyment, visitors rated themselves on a scale from one to nine where one was did not enjoy at all and nine was thoroughly enjoyed.

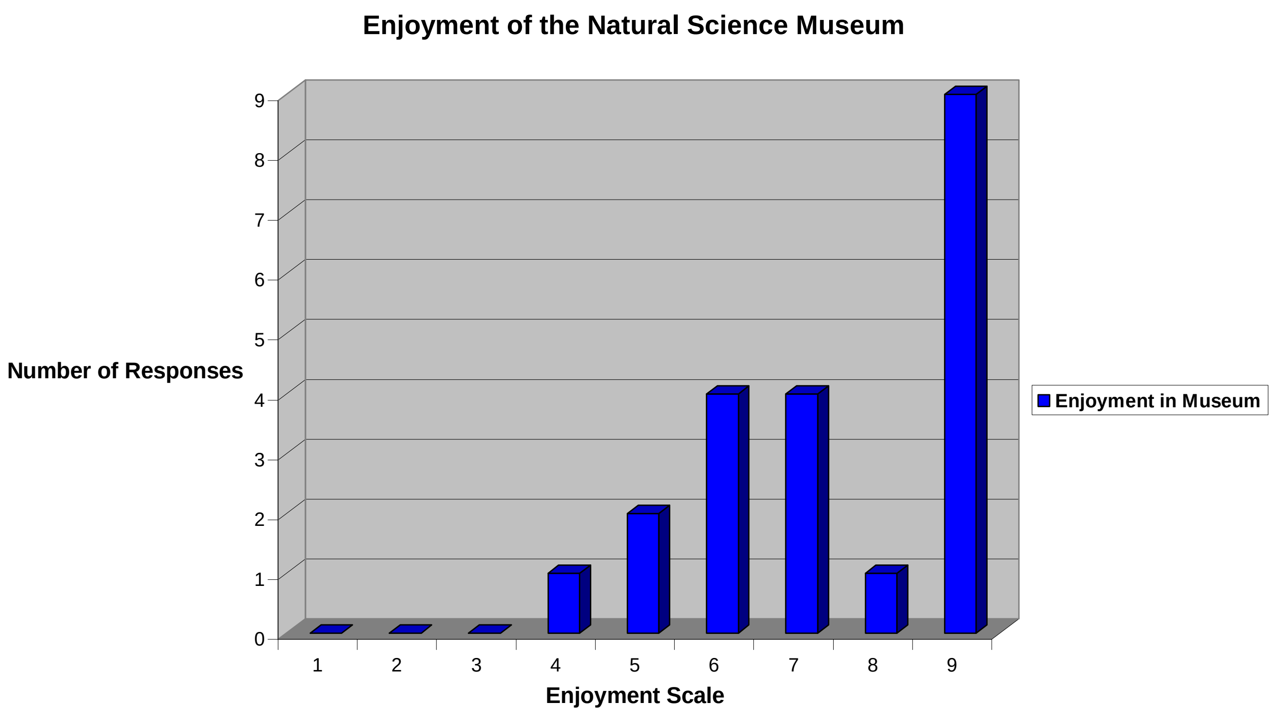

Figure 16: Enjoyment of the Natural Science Museum

In addition, twenty of the twenty-one respondents reported that they found the exhibits interesting. Also, most people felt that they were able to understand the exhibits well, with eleven visitors indicating that they had a very high understanding of the exhibits in the museum, see Figure 17.

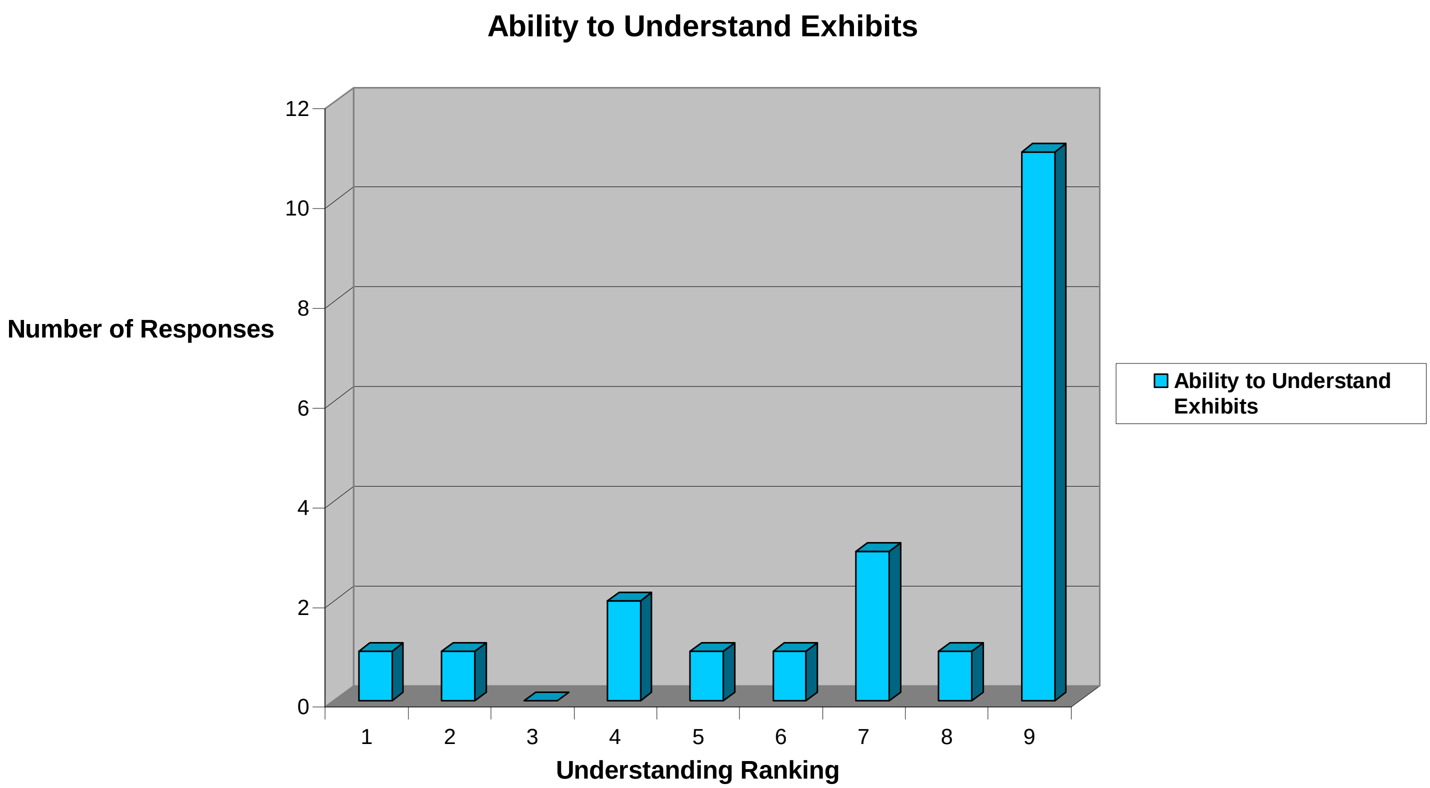

Figure 17: Ability to Understand Exhibits

Most of the visitors surveyed enjoyed the trip to the museum; however, four people gave an enjoyment ranking of six and seven each, two people gave a ranking of five and one gave a ranking of four. This may be caused by the lack of a tour during the Open House which many people have become accustomed to at the Natural Science Museum. This may also have been a result of people not understanding the exhibits; however, this is not represented in the responses regarding the visitor's ability to understand the exhibits. Based on our observations, we believe that many of the visitors did in fact enjoy their trip to the museum; however, we are not sure what they learned which may have differed from what the exhibits were trying to teach. This is a result of the non descriptive or all together lack of labeling on many of the displays, and the inability for children to interact and touch the exhibits. These are key concepts to museum design as mentioned by Beverly Serrell (2006), Veverka (1994), and Betsy Loring.

In the survey the visitors were asked to rank their favorite rooms from one to five, where one was their favorite and five was the least favorite. The following table below shows the responses for each of the rooms the favorability of each of the five rooms in the Natural Science Museum. The corresponding figures for each of the rooms are given in Appendix E-1.

Table 1: Favorability of Rooms in Natural Science Museum

	Number of Responses				
Ranking	**Main Room**	**General Ecology Room**	**Bird Room**	**Marine Room**	**Live Animal Room**
1	1	1	6	0	10
2	1	1	4	1	2
3	0	5	4	6	1
4	5	6	1	5	1
5	9	3	1	4	2

From this data it can be concluded that live animal room is the favorite room in the museum. When asked why this room was their favorite, visitor responses included “I enjoyed learning about the live animals”, and “Live animals because I like observing how animals move and how they look”. The rest of these responses for every room are given in Appendix E-2. This agrees with the opinions of most of the MMA staff members. As one member stated, “[parents] come because they want their kids to learn stuff and have an activity to do … [and] the only thing that draws the kids in is the animal room”. This data confirms our assumption that the live animal room would be the favorite room in the museum. Since this room appears to work at attracting visitors and educating children, we will not be updating its exhibits.

From this data it can also be concluded that the main room is the least favorite room in the museum. Visitors stated this room as being their least favorite because “I see it more as a gift shop, not an exhibit” and because “[the] Exhibits get lost or overwhelmed by the gift shop and you tend to pass by on the way to the other exhibits”. This last comment was frequently observed as mentioned in the section above.

Upon analyzing the open ended data we noticed several trends of the public's opinions. As we expected, the live animal room was the biggest attraction which was clear from the surveys. Out of the 21 surveys filled out, 13 of them mentioned one or multiple aspects of the live animal room when asked which their favorite room was. When asked which their least favorite room was, the results were scattered throughout the other four rooms but it was made clear that the main room needed the most help. Due to the space limitations in the main room as well as the frequency in which the room is used for programs and meetings, we decided that it was infeasible to try and update the exhibits in there. The most these exhibits need to get attention is for the tour guide to point them out to visitors during the tour and let those interested view them on their own afterward. We then asked our visitors which exhibits were the most easily understood. Not surprisingly, the most common answer mentioned something in the live animal room. This makes the most sense due to the fact that, although one of the key points of the Open House was that there was no tour to explain everything, we did have a staff member in the live animal room to explain things in there and keep an eye on the children for safety purposes. These results were not particularly helpful since we had already established from our interviews with the MMA staff, that the live animal room was the most successful and thus did not need any help from us in drawing in visitors. We did anticipate this however and had the follow up question "What displays did you find difficult to understand?" Of these responses, three people mentioned exhibits in the bird room, while three others commented that the labeling in general needed work. One comment in particular was also a much observed point that all us on the project team observed: "All of the labeling could be improved. Type is too small, ideas could be made more relevant". A lot of the labels are purely identification, sometimes not even the common name but rather the scientific name which means nothing to the average person. Finally when asked what would they like to see more of in the museum, some of the notable comments mentioned effects of erosion, which we heard many times afterward from local teachers, and more interactive exhibits in general. We used these comments along with all the other data collected during the Open House to build our prototype exhibits.

5.1.1.3 Determining Prototype Topics

The second task we had to updating the exhibits was to create and test prototype exhibits. To determine the topics of our prototypes we looked at the data from the Open House, as well as, our interviews with MMA staff members and school teachers.

One topic frequently mentioned by MMA staff and four of the school teachers we interviewed was erosion. This topic was also presented in the end survey from the Open House and in the Massachusetts Educational frameworks for third to fifth grade, see Appendix K. Since this topic, which is not clearly presented in the current museum, was suggested from all of our data sources we decided that one of our prototype exhibits would discuss erosion. The resulting prototype is known as the Erosion Book.

The second prototype idea came from a highly ignored and overlooked exhibit in the bird room. The Evolution Design Box is a case displays that contains a variety of different bird skulls that have different beak shapes and sizes with labels depicting what the common and Latin name of each of the birds. It is our belief that the exhibit was supposed to teach why certain birds have certain beak shapes and sizes; however, since there was no label mentioning adaptations or pointing out the differing beak shapes, we felt it wasn't a very effective exhibit and could easily be redone. When we analyzed that data from the Open House, it showed that the Evolution Design Box was the third most ignored display case in the bird room, tied with the Bird matching exhibit. The exhibits that were ignored more were wall panels that were too high for the children to read, the collection, which we can not really change and the Plover display, see Figure 18.

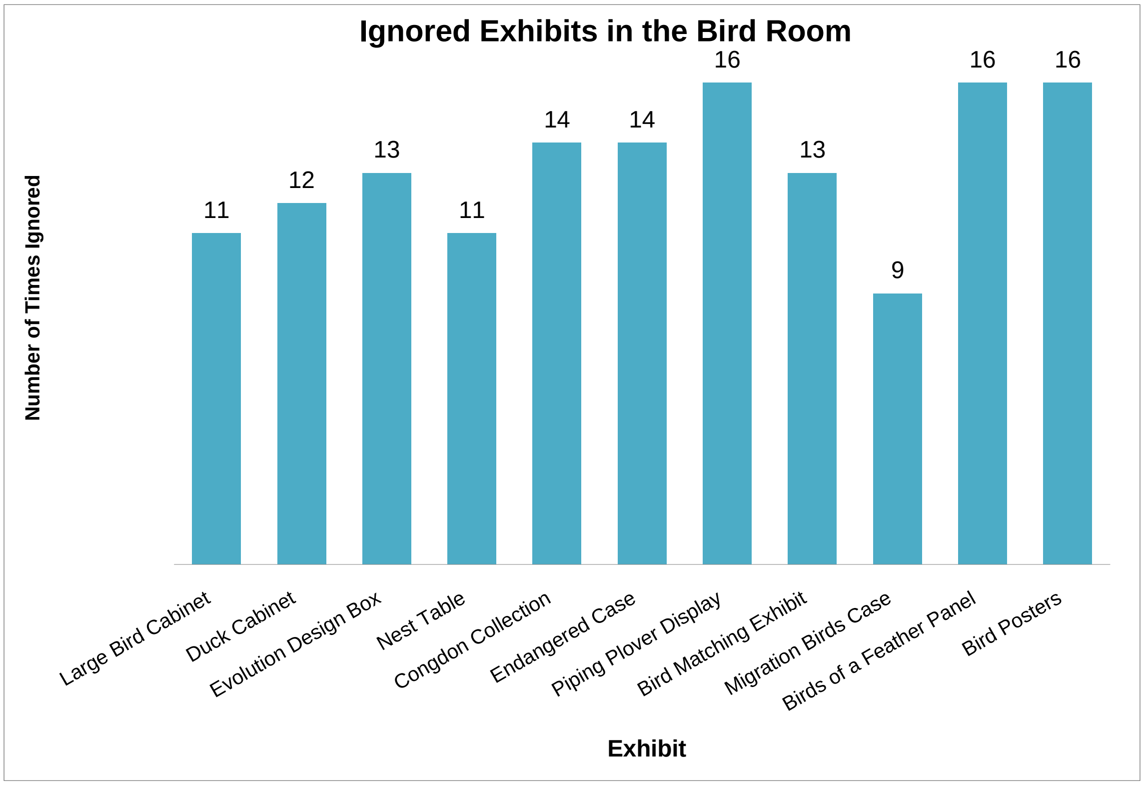

Figure 18: Bird Room Open House Ignored Observations

Adaptation was a topic that multiple teachers suggested to include in the museum and is included in the third to fifth grade frameworks given in Appendix K. We saw the Evolution Design Box as an educational and highly feasible candidate for a prototype. As we were designing our Bird Beak Adaptation prototype, inspired by the Evolution Design Box, we decided to expand our focus and created a second adaptation prototype on different types of Bird Feet Adaptations.

5.1.2 Prototypes

In order to determine how exhibits in the updated museum should be designed, we created a total of six prototypes. The topics of these prototypes were chosen based on recommendations from our interviews, and surveys, as well as, the Massachusetts Science and Technology/Engineering Curriculum Frameworks. These prototypes were then evaluated during school visits to the natural science museum. The following sections discuss where the exact recommendations for each prototype came from and evaluate the success of each exhibit after each visit.

5.1.2.1 Erosion Book

The erosion book prototype was derived based on pictures taken by Williams-Mystic students that were suggested to us by Dr. Bob Kennedy. Upon speaking with several teachers including the fifth grade teachers from Nantucket Elementary School: Mike Girvin, Kara Carlson and Janet Brannigan, we learned that erosion and geology were topics taught through out the elementary level. The topic of erosion was also suggested in one visitor's survey from the Open House as a topic they would like to see in the museum "Effects of erosion". Our sponsor and many of the MMA staff members also expressed interest in including this topic in the museum. The lesson taught in the book is mentioned by the Massachusetts Curriculum Frameworks for grades three to five Earth Science - Earth History learning standard No. 12, "Give examples of how the surface of the earth changes due to slow processes such as erosion and weathering, and rapid processes such as landslides, volcanic eruptions, and earthquakes".

5.1.2.1.1 Evaluation

5.1.2.1.1.1 Lighthouse School

The first school to visit the Natural Science Museum and test our prototypes was the Lighthouse School. Consisting of three separate groups broken up by grade, 20 Kindergarteners, nine 1st and 2nd graders, and fifteen 3rd, 4th, and 5th graders, each toured the museum for roughly an hour on November 18th. Since the Erosion book is such a small exhibit, the tour guide read aloud to the first two groups, while the third group had kids who read aloud to the others. For the first group, it was apparent from the beginning that the colorfulness, use of familiar materials, and picture book layout helped grab and keep the attention of the younger Kindergarteners. One unexpected behavior that we observed with first the kindergarten group, and subsequently in most groups afterward, was an urge the children had to associate themselves with a certain colored person in the book. During the introductory speech, which mostly consisted of asking if any in the group knew what erosion was, it was observed that children started calling out to each other "I'm gunna be the blue one" or "I wana be the purple guy". This was an unexpected response to the exhibit. It proved to also be beneficial because the kindergarteners noticed that people they originally chose to be began missing with the turn of the first page and started crying out that they wanted to be the red one instead (the person furthest from the cliff and closest to the house). The change in association the kindergarteners made shows that the children understood that the cliff was receding, which was what, the book was trying to show. Unfortunately we could not confirm this assumption with the first group, because no one in the group could read or write, and thus were unable to fill out the investigation packet. By the third or fourth page, the first and second grade children started noticing that the people were disappearing. With the 1st and 2nd graders, it took longer to notice the missing people because they were focusing more on what the text was saying rather than the corresponding visuals. When the third group read the book, it took the children just as long as the 1st and 2nd graders to notice the people were missing. We can conclude that the delayed realization is due to their increased ability to read the book on their own, a skill the third group displayed when a different student read each page out loud.

Another unexpected response was the recurring thought that the people who disappeared between pages must have fallen off the cliff, rather than move themselves out of harm's way. What made this response so surprising is that there were no hints or inclinations of where the missing people went. This rather morbid outlook on the book was indeed unexpected but did not hinder the learning involved in any way. As a result it did not spark any changes in the text between visitations. For the second and third groups it was observed that the children associated the house in the book with the Sankaty Heat light house near Siasconset rather than a residential building. This caused us to change the book slightly after the Lighthouse classes came through, since we believed that if the kids could associate the house with something they are familiar with, it would help them retain the lesson they learn through the prototype. The idea of connecting the exhibit to the visitor's private life came from Veverka's publishing's regarding exhibit design. The third group also showed us that while the erosion book got its point across well, it was a little to straightforward for the older kids. This observation was brought about when one child asked the tour guide if there was anything that could be done to undo the erosion damage to the beaches. Since erosion is such a huge problem on Nantucket, the Erosion book automatically addresses one of the criteria Veverka laid down for an interesting exhibit: relating to the visitor's life. This was a very complex issue that a child brought up, which made us think that we should include more thought-provoking questions within the book. These changes were made after the Lighthouse school visit and before the next school visit (see Appendix H-2 for text changes). By making this addition we made the book more interactive, and thereby fulfilled another of Veverka's ideals for an interesting exhibit which is to involve visitors in the exhibit. As the activity booklet raw data shows us, see Appendix E-3, the erosion book was a hit or miss for the first school visitation in terms of teaching its concept. When asked "What are some causes of erosion?" there were seven out of the nine 1st and 2nd graders who left the question blank or put a question mark. This could be caused by their deep concentration on reading the book rather than what the book is telling them. On the other hand, the 3rd, 4th, and 5th graders only had two blanks. However in both groups, those who did provide an answer were correct in their response as can be seen in the following two graphs, Figure 19 and Figure 20.

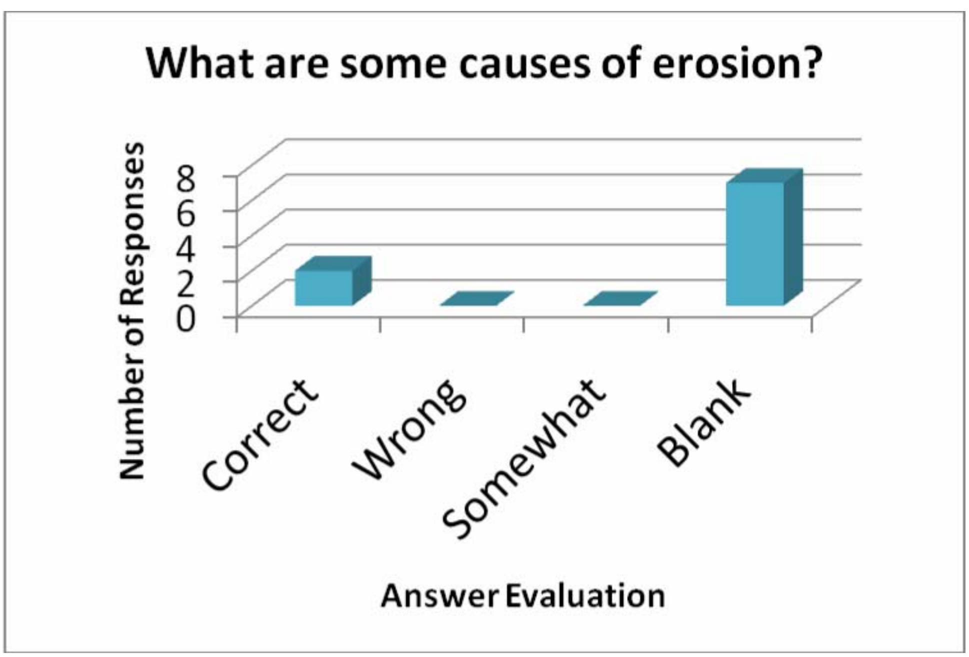

Figure 19: Response Breakdown for Lighthouse School 1st and 2nd Graders

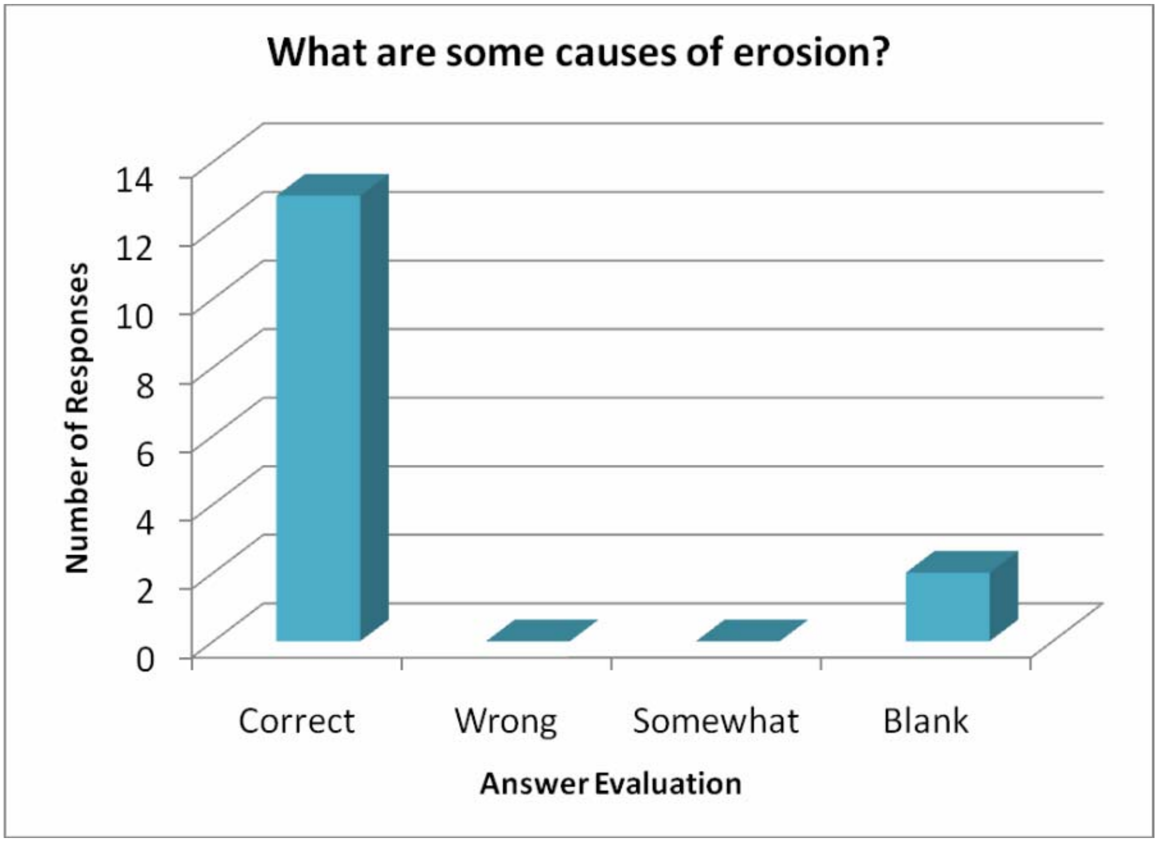

Figure 20: Response Breakdown for Lighthouse School 3rd, 4th, and 5th Graders

Due to the fact that, in its first test run, the Erosion Book had no thought provoking questions. This was reflected in the investigation packet answers. When compared to the other questions relating to a prototype, the Erosion Book did poor with the 1st and 2nd graders but quite well with the 3rd, 4th, and 5th graders, as seen in Figure 21 below.

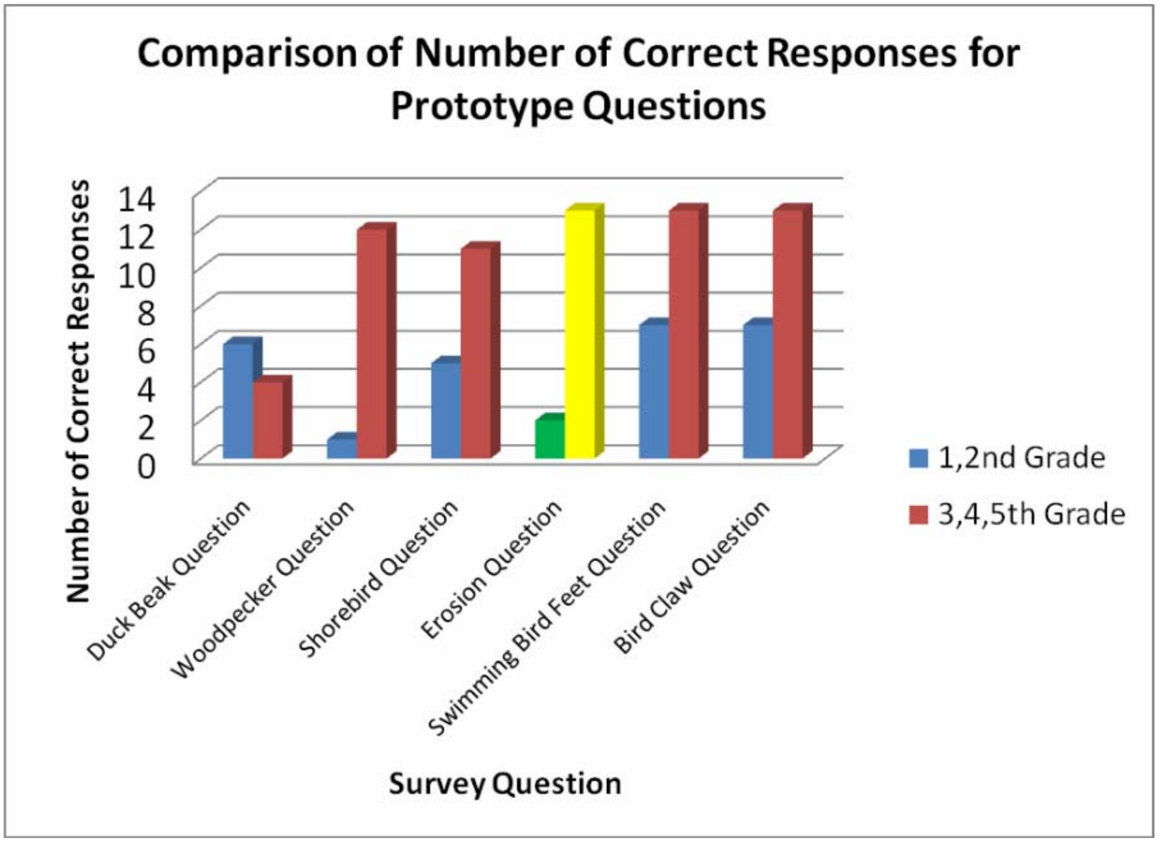

Figure 21: Comparison of Number of Correct Responses for Prototype Questions

To help engage the students more when presenting this prototype, we added some thought provoking questions to the text as well as introduced a more advanced concept to the audience based on a suggestion from one of our sponsors. We knew the next class, Mike Girvin's 5th grade, had recently studied erosion and wanted to make the book a bit more challenging. To do so we added a little section talking about the Angle of Repose and many other open ended questions that did not nessisarily have right answers.

5.1.2.1.1.2 Nantucket Elementary School: Mike Girvin's Fifth Grade Class

Mike Girvin's 5th grade class came in on November 20th, to tour the museum and test our newly updated prototypes. With 16 kids attending, there were lots of opportunity to observe interactions with the exhibits. Even though this class had little trouble reading, the erosion book was read to them, since the logistics of each student reading it individually were unrealistic. One major observation we made while the story was being read, was that the children were not associating themselves to the people in the book this time. One of the changes to the text that did bring about an interesting observation was our attempt to connect the book more personally to the visitor's lives here on the island. To do so we added the following question: "Where do you think the sand from Siasconset is being taken to?" To our surprise, when the tour guide read the word Siasconset, she got caught up on the word and it was observed that everyone in the class had confused looks on their faces. We realized from their reaction that even though the local term, 'Sconset, is a caloquialism it is so heavily used that no one understands the real name. While this reaction was more a product of culture shock, we still felt it important to change the wording so that it was more understandable to the local children. An alternative motive for adding this question was to bring the attention of the audience to other exhibits in the room. This was done to prevent the interactive prototypes monopolizing the attention of visitors in any given room. In this case, the question applies the concept to a specific section of the island, that can be looked up on the maps around the marine room. When the tour guide came to the question she ushered the attention of the group to the giant bathometric map in the middle of the room. The overall success of the prototype far exceeded the last group, as can be seen from the number of correct responses provided at the end of the tour when asked "What are some causes of erosion?" Shown below is a pie chart break down of the responses given for this question.

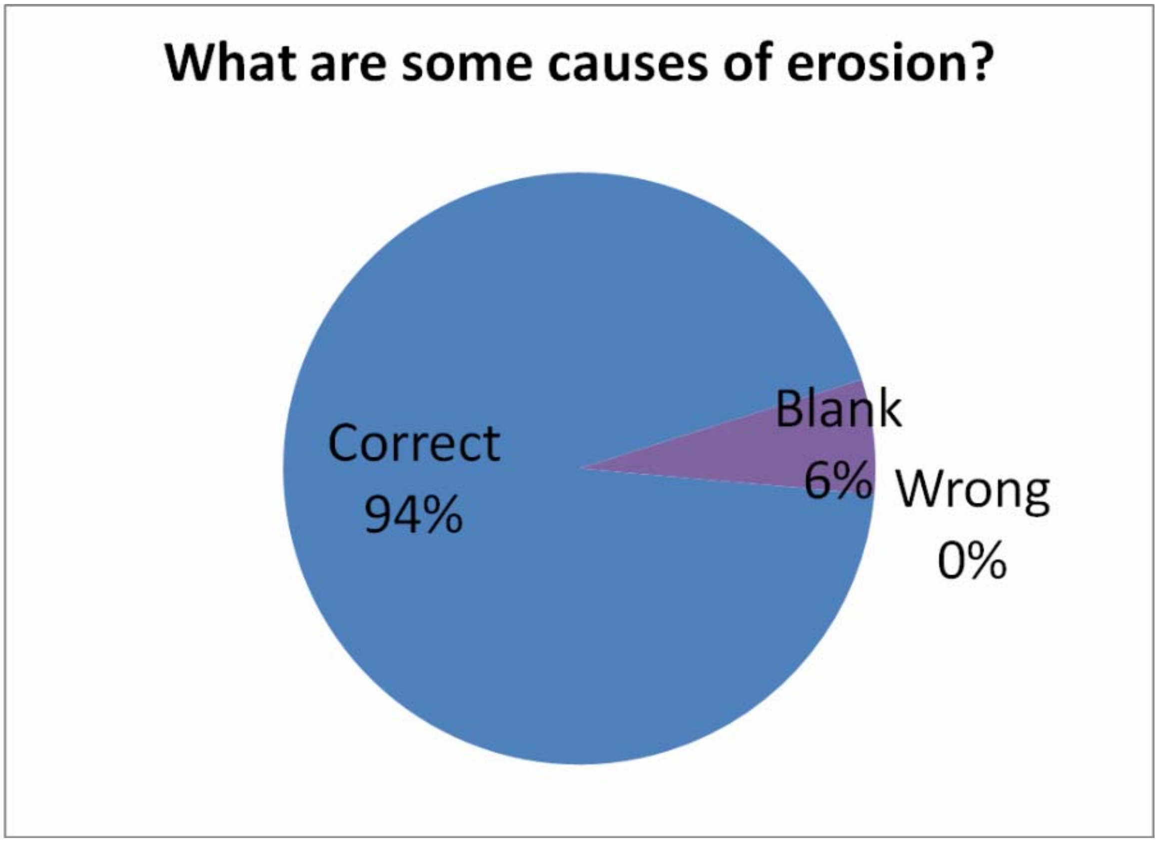

Figure 22: Percentage Breakdown of Erosion Question Responses for Mike Girvin's 5th Grade Class

As you can see there was almost a perfect number of correct answers, with only one blank response recorded. The erosion book had the second highest correct response rating for this group, seconded only by a perfect score regarding the bird feet adaptation prototype. The stunning success of the erosion book led us to believe that other than the minor changes mentioned above, no additional changes were needed before the next class came in.

5.1.2.1.1.3 Nantucket New School Third Grade

We schedualed our next visitation to be after break on December 4th. This group was a 3rd grade class from Nantucket private school: the New School with 13 kids attending. Since this group was just learning how to read, the tour guide once again read the erosion book out loud to them. This class was very enthusiastic about their visit to the museum and particpated in everything with eight of the thirteen kids answering the questions posed in the Erosion book. The students were also able to pick up on the disapearing people in the book faster than any previous group. As can be expected, the survey responses relating to the Erosion prototype were exceptional. First of all, there were no blank responses recorded. Further emphasizing the success of the Erosion book, all but one of the writen responses were correct. The outlier wrote a correct response but put a "?" at the end. We interpret this to signify that, although the child could provide a correct answer, he/she was not sure of it, and thus the credibility of the proof of learning is questionable. Instead we counted this response as a "somewhat", because the child learned the concept but not fully enough to be confident in his/her answer. Even with this one somewhat, that yields a correct response percentage of 92%! By now, the Erosion book has ascended to the most successful prototpye we've built due to its understandability and how well the topic is retained by visitors. The Erosion Book's streak of high marks only goes up as the next group, from the Boys and Girls Club, come to visit.

5.1.2.1.1.4 Boys And Girls Club

Later on the 4th of December, we had 6 kids from the Boys and Girls Club visit. We used this group to test the effects of the environment in which the prototypes were placed on the responses we recieved. To do this we brought the prototypes out to the big front room and spread them out over a couple of tables. Also, we did not provide them with the tour that every other group went through. With no tour guide to read the Erosion Book to them, Molly Congdon read it to them while the other two in the group observed. One of the main observations made early on was how shy this group seemed. We attribute this to the lower numbers in the group. Another concern we came across when presenting the book to them was our multitude of questions. Since this group was not any single age or grade, we felt there might have been too many questions for the younger visitors. If kept as a permanent exhibit, this problem can be addressed by having the tour guide simply skip the questions they deem too advanced for the audience, or if visitors opt out of the tour, the guardians of the children can explain that which is too difficult to understand to them. When the 6 kids from the Boys and Girls Club had finished manipulating the prototypes, we once again asked that they fill out both the investigation packet and the end survey. When analysing the results of these six packets, we recorded an astonding 100% correct response rate for the question regarding the Erosion Book. Due to the continued high number of correct responses, we can conclude that the book can be successful independent of it's environment in which it was originally put. The increased percentage of correct answers is possibly due to the small size of the group, which provided a more intimate and personal experience for the visitors than being herded around in a class.

5.1.2.1.1.5 Nantucket Elementary School: Janet Brannigan and Kara Carlson's Fifth Grade Classes

The last two groups of students were both from Nantucket's Public Elementary School and were both 5th grade classes. We made no changes between the Boys and Girls Club visit and the last two visits other than moving the prototypes back into their previous places in the museum.

Due to the similarity between these two classes, they will be analyzed as one big group, consisting of 35 students. Both classes were very eager to learn and were quite responsive to the prototypes. The classes were able to notice the missing people in the book within the first couple of pages, and answered the questions thoughtfully and intellectually. Of the 35 students, only one left the question in the investigation packet blank, two gave wrong responses, and two gave somewhat correct answers. This yielded a total of 30 correct answers or 85% correct. Considering the large size of the groups, it is very impressive to receive such high marks.

Below is an overview of percentage of response correct for the various school groups that came in, when asked "What are some causes of erosion?"

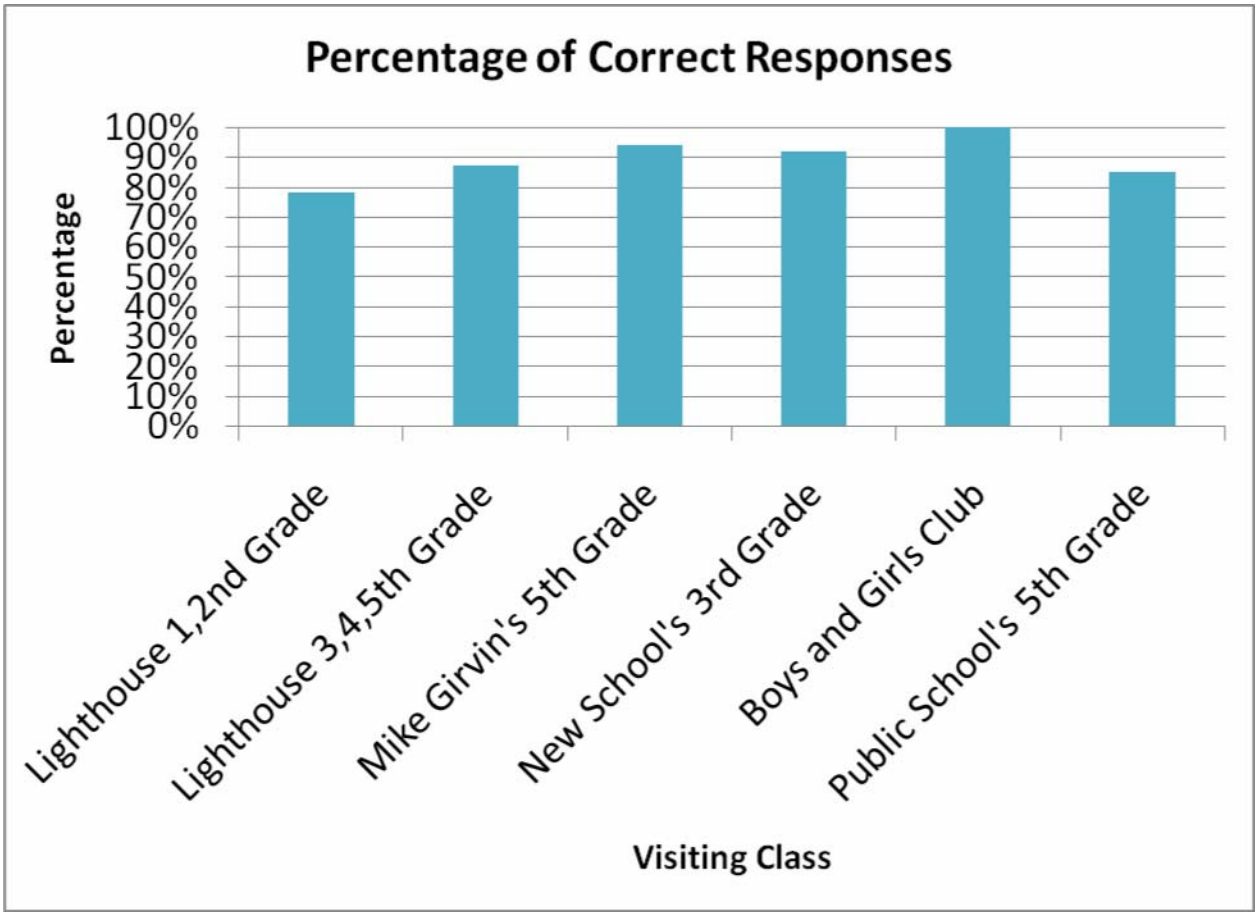

Figure 23: Percentage of Correct Responses for Visiting Classes on Erosion Question

Based on the great response rating of this prototype, with the lowest percentage being still over three quarters of the audience tested, this was a very successful exhibit and one that should be considered for installation as a permanent exhibit in the museum.

5.1.2.2 Bird Beak Adaptation

The Bird Beak Adaptation prototype was derived from a similar exhibit in the Museum of Science in Boston. After speaking with several teachers regarding the science topics they teach to our target age group, one of the most common lessons was adaptations and how plants and animals change their physical characteristics to better survive in their changing environment. This lesson stems specifically from the Massachusetts Curriculum Framework for grades 3-5 regarding Life Sciences: Adaptations of Living Things (Learning Standard No. 6), which instructs teachers to: “Give examples of how inherited characteristics may change over time as adaptations to changes in the environment that enable organisms to survive, e.g., shape of beak or feet, placement of eyes on head, length of neck, shape of teeth, color." The prototype also relates to other frameworks such as the K-2 Life Sciences: Characteristics of Living Things (Learning Standard No. 1) and 3-5 Life Sciences: Characteristics of Living Things (Learning Standard No. 1) see Appendix K.

5.1.2.2.1 Evaluation

5.1.2.2.1.1 Lighthouse School

Our first school visitation was on November 18th with the K-5th graders from the Lighthouse School. There were three groups that came, first the Kindergarten class of twenty kids, followed by the 1st and 2nd graders, with nine kids total, then the 3rd, 4th, and 5th graders, with fifteen total kids. All groups had little trouble manipulating the beak adaptation prototypes although there were some unexpected results. To our great surprise, the first group could neither read nor write and the second group could barely read and only half could write so none of our labels were read independently as we expected. Because the first group couldn't write, we opted to not give them the end survey. To accommodate we read the exhibit labels aloud so the instructions were understood as to how to manipulate the prototypes properly. Another unexpected result was the lack of free choice learning. The teachers were constantly reprimanding children whose attention wandered away from what the tour was covering at the time, and so our prototypes were only paid attention to when it was their turn. This made it feel like we were showcasing our prototypes rather than having them discovered as something new in the museum. For the Lighthouse School visits, all kids manipulated the bird feet adaptation prototype. It was also observed that, before the tour brought the attention of the children to the prototypes some children did pay attention to them, as seen in the following graph:

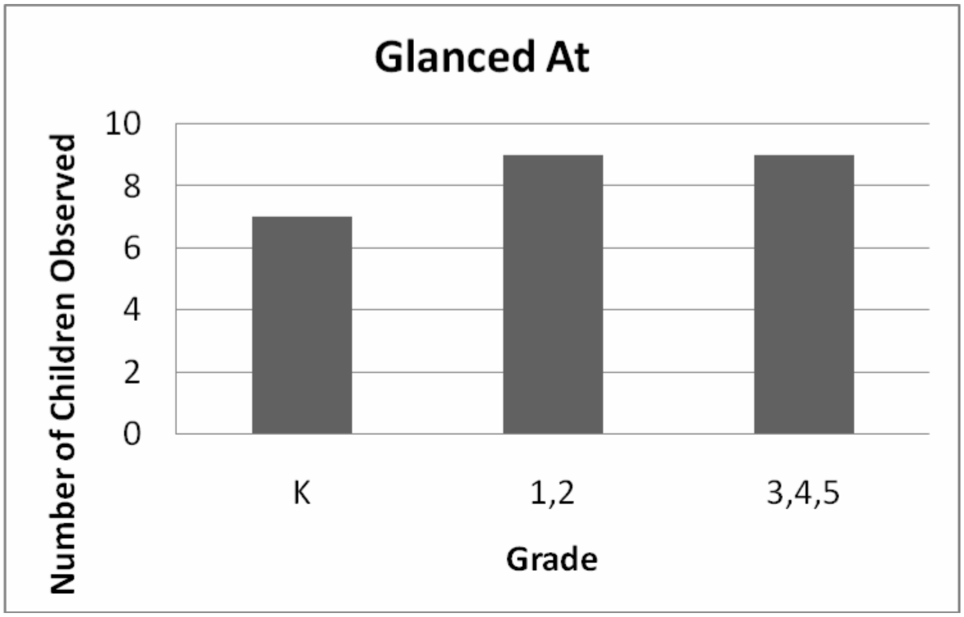

Figure 24: Beak Adaptation Prototype Glanced At Observations

We interpreted the children glancing at the prototypes before they were told, to mean that if free choice learning was promoted instead of tour based guidance, the prototypes would be attractive to our target audience. As was said previously, the first and most of the second groups did not read the labels since they couldn't read, however one from the second group and six from the third/forth/fifth graders were observed reading the labels:

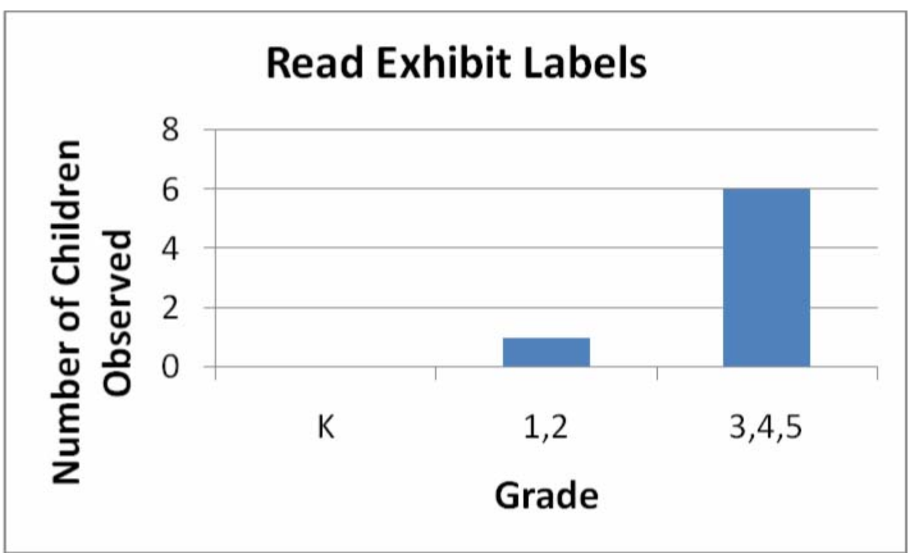

Figure 25: Beak Adaptation Prototype Read Exhibit Labels Observations

It is our belief that the increase in label reading not only stems from ability but also from the ease with which the students can read. We concluded that the older the student, the more willing they seemed to read the labels. However our interview with Betsy Loring, of Worcester's EcoTarium, informed us that to best capture and keep an audience's attention, labels and text associated with exhibits should be kept relatively short. This idea was echoed in our interviews with teachers who also indicated to us that as a child is learning to read, the act of reading is work and, as such, any labels we do include should be of minimal length.

Each prototype ran into at least one problem that needed to be addressed before the next group came in. For the sandpiper it was observed that even though the functionality of the pliers was significantly decreased at the bottom of the container of sand, if plunged down it could still reach the bottom, which defeated the purpose of the comparison. Unfortunately we could not find a substitute item to compare with before the second group from the Lighthouse school came in, and so we faced the same problem with the second group. One other observed response from the 3rd, 4th, and 5th graders is they seemed more goal oriented when manipulating the sandpiper exhibit as several asked whether they were supposed to be looking for something in the sand container. This inspired a change in the exhibit text for the next school visit. The duckbill had a minor problem, in that the comb had teeth that were so close together that the sand could not pass through it as easily as hoped. This problem was deemed negligently small however since it could still sift out the rocks and serve its purpose. The woodpecker also had a minor problem in that a few kids seemed determined to stab off a piece of bark with the nail instead of just "pecking" to feel the difference in resistance. This was merely an inconvenience since it caused a bit of a mess on the table.

After the end of the tour we had both groups fill out an activity booklet which included questions that tested the groups' comprehension of the prototypes and the lessons they were supposed to teach. This activity booklet can be found in Appendix D-5 and D-6. The activity booklet asked questions about why do woodpeckers and sandpipers have the beaks they do as well as "how is a duckbill like a comb?" We then analyzed the answers and categorized them as right, wrong, partially correct, or blank. We instructed the kids that if they did not know the answer they could either put a question mark or leave it blank and so every question mark was counted as blank. A partially correct answer was deemed as close but not exactly correct and so it was questionable as to whether the child actually learned the lesson or the answer shows that they remember the exhibit but not the lesson it was trying to teach. A prime example for the latter is when asked "How is a duckbill like a comb?" one response was "because it combs out the sand". This shows that the child remembers the exhibit associated with the question but did not retain the lesson it was teaching. Even though the child understood how to manipulate the exhibit, and what was supposed to be accomplished at the exhibit, the response shows that the child couldn't associate the action performed at the exhibit to the concept of a duck filtering out its food. One example of whether a child's learning was questionable is shown when asked "Why couldn't a woodpecker's beak be soft?" a response is given of "it would not work". In this case, the child could have learned that it wouldn't work because it would break when pecking; or the child could have simply guessed the answer from the question's wording of "couldn't" which implies that it would not work. We then analyzed the answers and tabulated them to compare comprehension levels between groups. For example as seen below in Figure 26, a table of the various responses from the 1st and 2nd grade group when asked "How is a duckbill like a comb?"

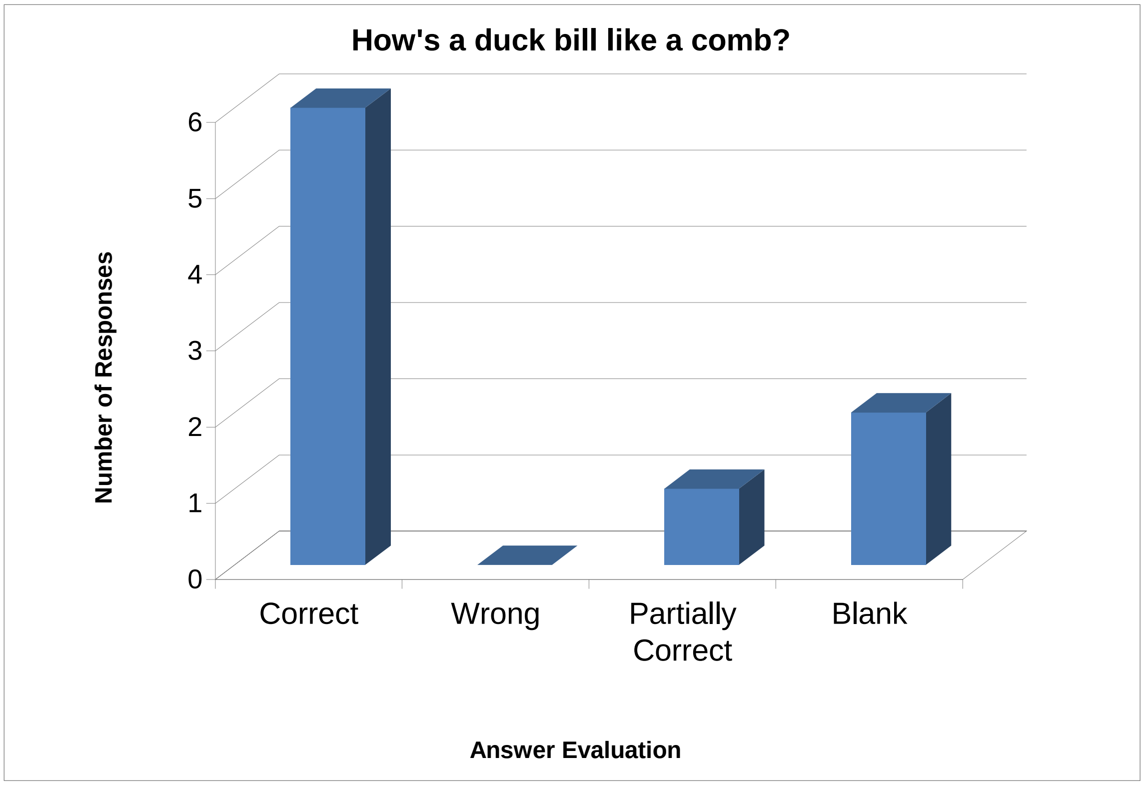

Figure 26: Lighthouse School 1st and 2nd Grade Duck Bill Question Responses

Out of the nine kids in the first group, six of them got the question right, with one somewhat answer and two blanks. We found that the second group did surprisingly worse when given the same question with 10 out of 15 leaving the answer blank. One of the most plausible reasons for this is that we explained the exhibits in more detail to the first group since they could not read the labels, whereas the second group could read; and so when asked "how does this work", instead of explaining, we urged them to read the labels and figure it out for themselves. The blanks could just as well be a lack of interest in filling out the activity book. Whatever the reason, the amount of blanks the second group had is much more than that of the first group as seen below in Figure 27.

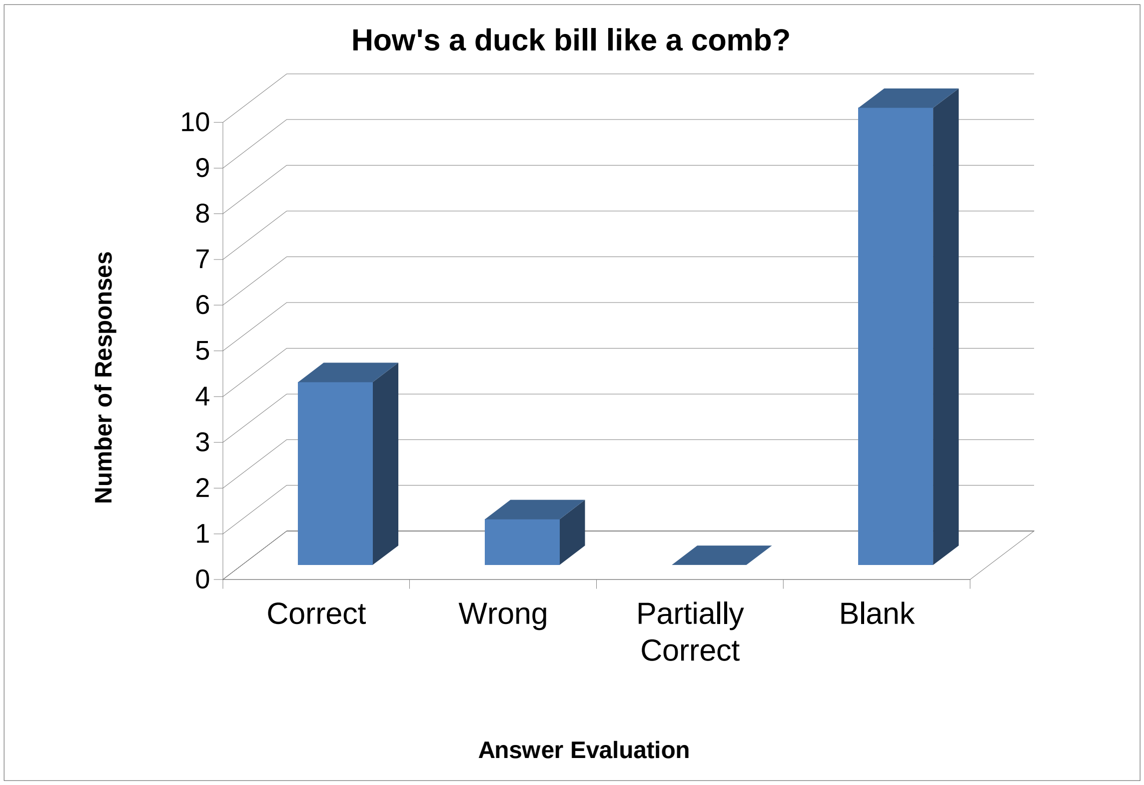

Figure 27: Lighthouse School 3rd, 4th, and 5th Grade Duck Bill Question Responses

Our judgment of relative success of a prototype is based on our feedback from the activity booklets and the correctness of the responses we got from the students. Of the three bird beak adaptations for the Lighthouse visit, the first group showed the most understanding of the duck bill exhibit, followed closely by the sandpiper prototype. Conversely the second group understood the duck bill prototype the least and the woodpecker exhibit the most. Figure 28 below shows a graphical representation of the understanding of the Lighthouse visitors.

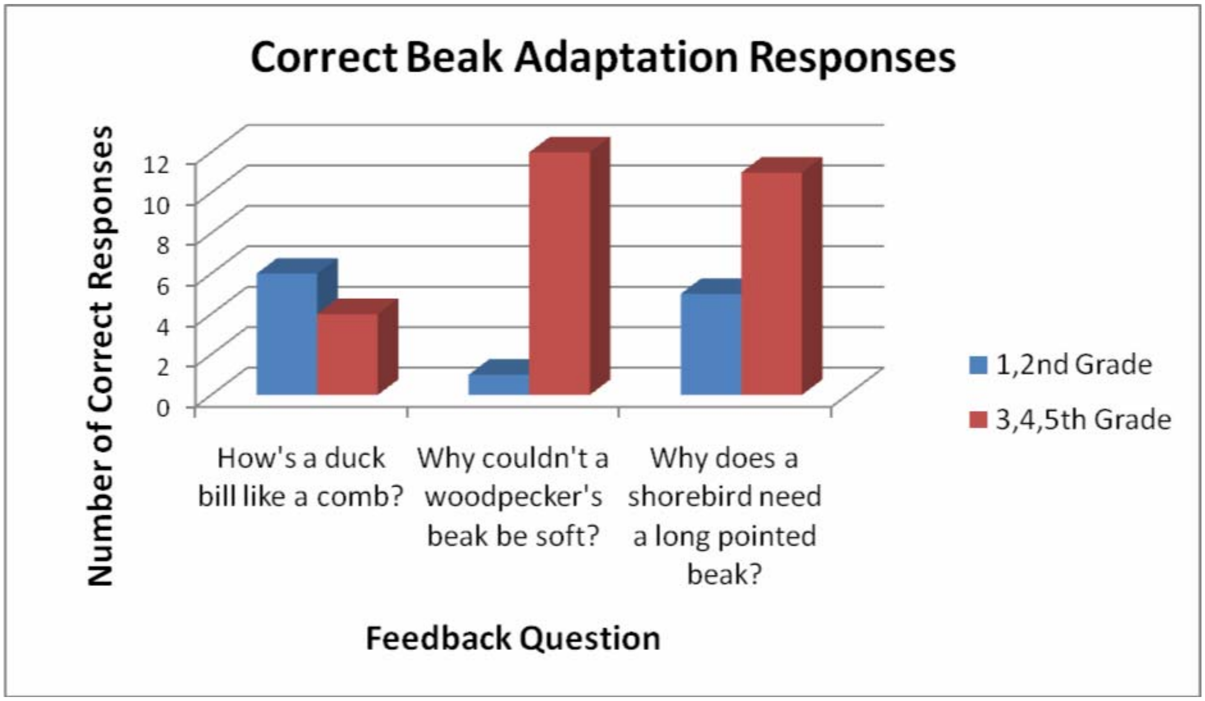

Figure 28: Lighthouse School Correct Beak Adaptation Responses

The drastic lack of correct answers from the 1st and 2nd graders for the woodpecker is caused by a third of them writing down the answer to a different question in the space provided, as can be seen in the raw data in Appendix E-3.2. This leads us to believe, however, that they left them blank because they didn't know the answer. The fact that they did not know the answer tells us that, even though all nine of the second group was observed to manipulate the exhibit, they did not retain the lesson the prototype was trying to teach. Since the lesson hinged mostly on the visitor reading and comprehending the label, and only half the second group could read, it only follows that they would not learn the lesson being taught. For the other group, the majority did not answer the duck bill question correctly. This is due to the number of answers left blank: a surprising ten out of fifteen. Of the five that did provide an answer however, four gave a correct response, with the fifth simply stating "not sure". This high number of blanks and unsure answers is easily explained by the high level of abstractness the duck bill prototype contains. It is unknown to most adults that ducks have teeth-like growths on the sides of their bills and so simply describing it was not enough for the students to understand. One of the renovations we did to counteract this vagueness for the next class, Mike Girvin's 5th grade class, was to print out a picture showing a close up of the adaptation we were trying to teach.

Based on our observations of interactions with the prototypes on the 18th, we made some minor changes to the text of the prototypes. First, as stated previously, we printed out a blown up picture of a duck's bill to show the filter-like growths, to help with visualizing the adaptation. Also, to further grab the attention of the visitors, we added the rhetorical question: "Did you know that **ducks** have physical features like **whales**?" Since the Nantucket community is so oriented on whales, given their whaling history, we figured it would be more interesting to compare the duck prototype to something they are already familiar with.

The next change we made was based on the low correct response rate with the younger students when given the question "Why couldn't a woodpecker's beak be soft?" With only 1 out of 9 kids giving a correct response, we felt the text might need to emphasize the correct answer more. To accomplish this we broke the original text down into two smaller sentences that both mentioned that the woodpecker eats bugs living under the bark, thus doubling the likelihood that the lesson will be retained. One of the main changes we made to the bird beak adaptation exhibits was to change the tool used in the woodpecker exhibit. After showing our prototypes to our sponsors, it was voiced that the nail could be a liability and safety issue and it was suggested to use something else, such as a chisel or screwdriver. It was our opinion that a chisel could do far more damage than a nail and so a screwdriver was substituted for the nail. Also, to help with the safety issue, we tethered the screwdriver to the table using some yarn. This also helped keep the tools with their respective exhibit, since we experienced some trouble with tools being used in the wrong exhibit.

5.1.2.2.1.2 Nantucket Elementary School: Mike Girvin's Fifth Grade Class

Our second school visit was from the Nantucket Public School. The fifth grade teacher, Mike Girvin, brought his class of sixteen to the Hinchman House on November 20th. Based on our interview with Mike prior to his visit, we expected a very smart and well behaved class. Our expectations were met half way, a very smart class but quite rowdy. Mike explained this on the lack of opportunities to get out of the classroom. One definite plus was the fact that everyone in the class could read and it was observed that almost everyone read the prototype labels, which showed in the responses to the investigation packet. It was observed during the visit that all of the children showed interest in the exhibits, and all but one chose to manipulate them. This lone child who opted to not participate was particularly shy but nonetheless showed interest in the exhibits. After introducing the prototypes, and answering any questions regarding them, we observed the various types of interactions the students performed. These were tallied under the same categories as the previous groups for consistency purposes. Table 2 below shows the breakdown of the observations made for the bird beak adaptation prototypes.

Table 2: Observation Breakdown for Beak Adaptation Prototypes for Mike Girvin's 5th Graders

Action Observed	Number of Observations (16 kids total)
Glanced at	16
Read exhibit labels	12
Ignored	0
Pointed at	0
Asked questions about	5
Explained	0
Manipulated	15

As can be expected, a vast majority of the group manipulated the exhibits in both visits but the increase in read exhibit labels and thought provoking questions asked shows that the exhibit was well received by Mike's class. One of the main issues we had with this visit was the destructive nature of the students, particularly the males, who were in the group when manipulating the woodpecker exhibit. It was observed that, since the screwdriver was a longer tool and provided a much more natural grip in the hand, the kids were able to hold the tool more firmly and thus make stronger and more violent strikes against the log. Despite this minor issue, there is ample evidence provided when analyzing the investigation packet responses that Mike's class enjoyed the exhibits thoroughly and learned from them too.

Mike's class was a very smart group of individuals, which can be seen clearly from the responses they provided on our end questionnaire. The lowest percentage of correct answers was 25% when asked about the shorebird exhibit. The following graph compares the number of correct responses to the investigation packet given to the class after the conclusion of the tour.

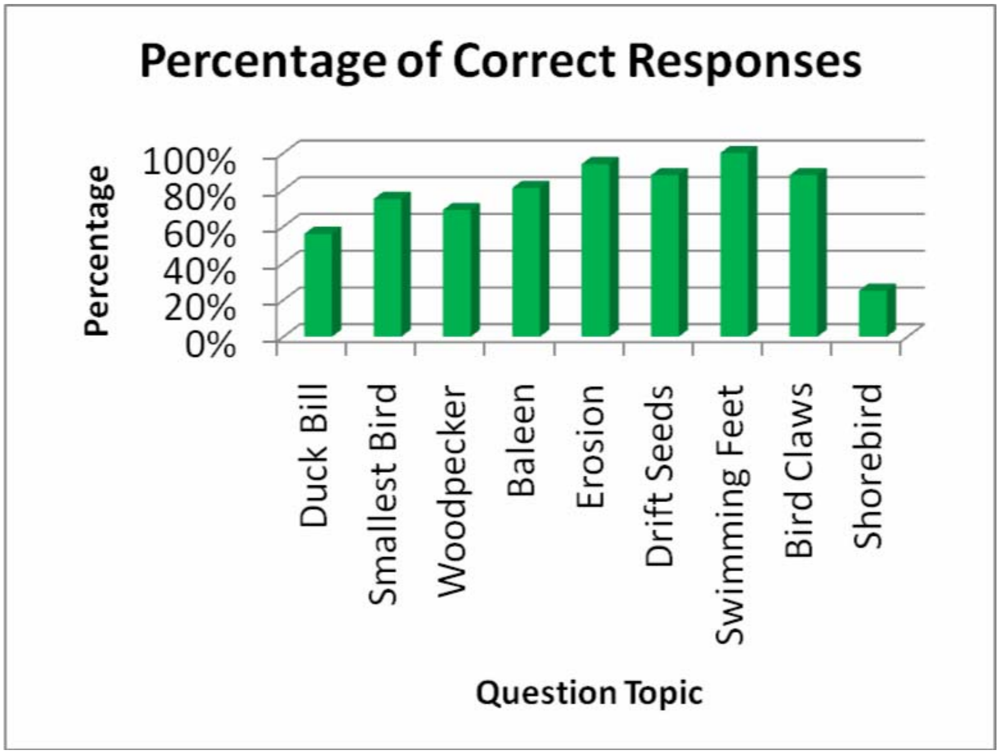

Figure 29: Comparison of Percentages of Correct Responses

As can be seen, there were a high amount of correct responses for most of the questions asked. Stated previously, the shorebird had the least number of correct responses, four, with 11 forms left blank. This was probably caused by the woodpecker exhibit's attraction overshadowing that of the shorebirds. Another possibility is the seeming lack of a goal the shorebird displayed. One child, while manipulating the shorebird exhibit, asked whether they were supposed to be searching for something in the sand. This caused a change in the text in preparation for the next school visit.

Comparing Mike Girvin's class with the third group of the Lighthouse School yields a shift in excellence from the students, as can be seen in the table on the next page.

Table 3: Comparison of Correct Answers given by Mike's 5th Graders and Lighthouse School's 3rd, 4th, and 5th Graders

	Duck Beak Question	Woodpecker Question	Shorebird Question
Light House 3,4,5th Grade	27%	80%	73%
Mike Girvin 5th Grade	56%	69%	25%

In this table the percentages represent the percent of correct answers for a given question. As one can see, there is a significant increase in comprehension of the duck bill exhibit, which can be attributed to the addition of a visual. There is also a slight decrease in the comprehension of the woodpecker prototype. We associate this loss in understanding to the fact that to the class it seemed more fun to just stab at the stump than to read the label and try the comparison out for themselves. This disruptive behavior impeded the learning process by providing an alternative motive for manipulating the prototype: to destroy it. Due to the violent manner in which the kids manipulated the exhibit, it was determined that for safety reasons the prototype should be taken apart for the remaining school visitations. We also felt it was not doing a good job at teaching its lesson since children were more likely to just play with it than read the labels and try to learn.

To replace the woodpecker exhibit, we came up with the seed cracking exhibit. Before the next visitation from the New School on December 4th, we had a week off for Thanksgiving break. When we returned we immediately started working on devising how to portray the seed-cracking beak exhibit and constructed it.

5.1.2.2.1.3 Nantucket New School Third Grade Class

Our next visitation we set up for the New School to bring in one of their 3rd grade classes, with a total of 13 kids. As with before, the third graders showed some trouble with reading the labels; although they could read them, we had to encourage them to do so. One of the main observations made when the class was manipulating the beak exhibits was the popularity of the new seed cracking exhibit. The kids showed the same enthusiasm as the woodpecker exhibit, if not more; however it was hard to tell again if they were learning the concept or just enjoying cracking seeds open. To test the effectiveness, one of us asked the manipulators how the exhibit related to real life, as well as the question posed to them by the label. At the time, almost all were able to relate a correct response, and if it was wrong, we would suggest that they read the label to find out. However, compared to the other prototypes, the new seed cracking one didn't seem to stick with the children as well, as can be seen in Figure 30.

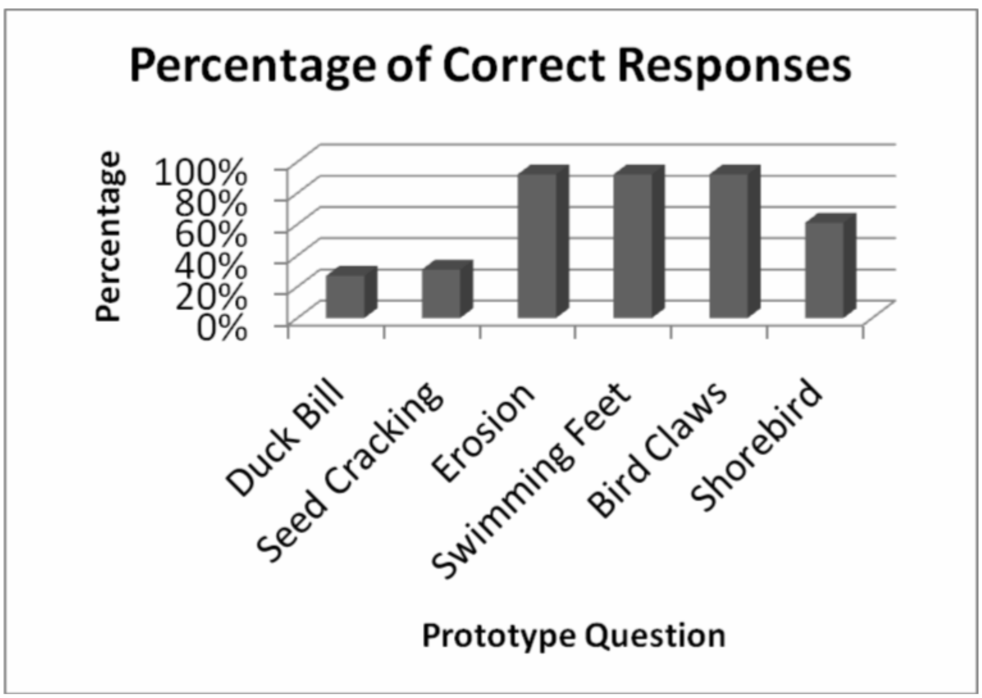

Figure 30: Comparison of Percentage of Correct Responses for Prototype Questions

The duck bill and seed cracking prototypes had the most difficulty in teaching this class. One of the main reasons for the lack of correct answers for this group the duck bill lesson was their difficulty in connecting the exhibit to real life. The connection is spelled out simply in the label but as said before, not many read the exhibit labels, since reading is such a challenge for them. This can be concluded by the many responses stating that a duck bill is like a comb: “because its bill can sift threw [through] sand easily”.

The seed cracking exhibit had a relatively low number of correct responses as well. Despite the clarity of the text that short, hard beaks are typically used for seed eating; the message did not seem to get through to a majority of the kids in this group, who provided various other answers. Among the incorrect ones were: “meat”, and “crabs, clams, jellyfish, and squid”. There were also multiple students who responded that the short, hard beaks are used for eating insects; which is the exact opposite according to the text. This again, leads us to believe that the class did not pay much attention to the labels set in front of them.

When compared to the Lighthouse’s group of 3rd, 4th, and 5th graders, they did about the same on the two prototypes that are similar to both: the sandpiper and the duckbill. Table 4 below shows the percentages of correct responses for each class for both prototypes.

Table 4: Percentage of Correct Responses for Both Private Schools

	Duck Beak Question	Shorebird Question
Light House 3,4,5th Grade	27%	80%
New School 3rd Grade	27%	61%

The New School’s 3rd Grade class did just as well on the duck bill prototype question as their peers and not as well with the shorebird question. Even though the New School had the visual of the duck beak, they still had trouble connecting the exhibit to real life, which caused a decreased number of correct responses. Possible reasoning for the slightly lower number of correct responses on both questions stems from the difference in demographics between the groups. The Lighthouse School’s third group included third graders, but only 3 out of 15, which means 4/5 of the Lighthouse's demographics were older than that of the New School's 3rd graders.

5.1.2.2.1.4 Nantucket Boys and Girls Club

The next group to tour the museum was another medley of grades and ages: the Boys and Girls Club. This is the local after school program, where parents can drop off their children after school, and they can socialize and have fun. We received a group of 6 kids: two fourth graders, two first graders, one third grader, and one unknown since the individual refused to fill out a survey. The interactions observed were atypical of the previous three groups. Firstly, we isolated the prototypes by bringing them into the main room to test the impact the environment in which these exhibits were displayed. Also, the children seemed much shyer and withdrawn, with only two boys doing most of the reading for the others, and not everyone interacting with the exhibits. They also showed decreased enthusiasm for being part of our observations. This was most likely due to their wish to go socialize with their peers who weren't being observed. We only had a group of six, because that was how many permission slips were filled out. So these six were separated from their peers to participate in our study while their friends got to go play ball in a nearby field. Unlike a field trip setting where children are taken out of the classroom setting, this likely felt as if they were being placed into a classroom setting. These factors showed in their responses to the end evaluation. For the three Bird Beak adaptation prototypes the highest number of correct responses was three out of six for the seed cracking exhibit. The lack of interest on their part in participating seemed to be the cause for this unusual amount of incorrect responses and blank questions as can be seen in Table 5.

Table 5: Breakdown of Responses from Boys and Girls Club Participants

	How's a duck bill like a comb?	What type of food do birds with short, hard beaks tend to eat?	Why does a shorebird need a long pointed beak?
Correct	0	3	2
Wrong	1	1	2
Partially Correct	1	0	1
Blank	4	2	1

As before, the responses deemed "partially correct" mentioned part of the answer being sought however it was not clear whether they fully understood the concept being taught by the prototypes. In this case both mentioned getting food, which is right but we were trying to teach *how* birds get to their food.

5.1.2.2.1.5 Nantucket Elementary School: Janet Brannigan and Kara Carlson's Fifth Grade Classes

The last two groups of students were both from Nantucket's Public Elementary School and were both 5th grade classes. We made no changes between the Boys and Girls Club visit and the last two visits other than moving the prototypes back into their previous places in the museum.

Due to the similarities between these two classes, they will be analyzed as one big group, consisting of 35 students. Below is a chart depicting a breakdown of responses to Bird Beak Adaptation questions for all thirty-five students.

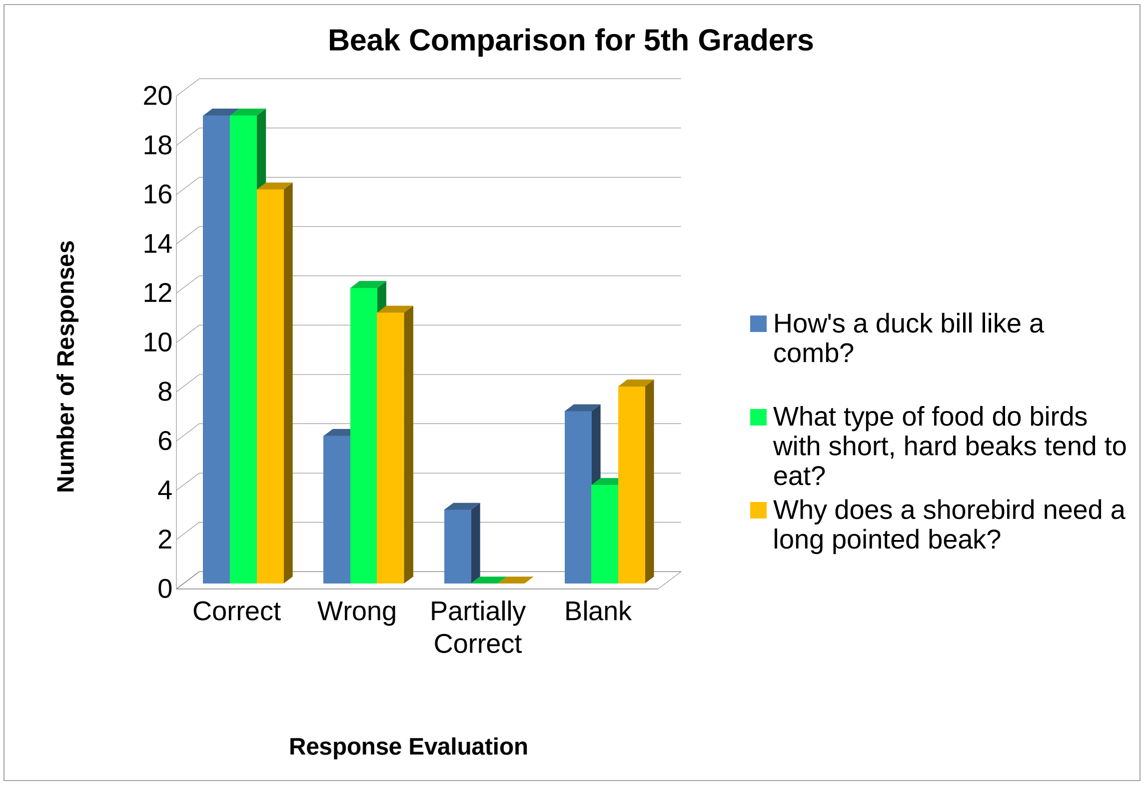

Figure 31: Breakdown of Responses to Beak Adaptation Questions

It is clear that these classes were very attentive and smart from their responses, and indeed it was observed as one of the most well behaved classes we had come through. Compared to the size of this group, they still did consistently well as can be seen in Figure 32.

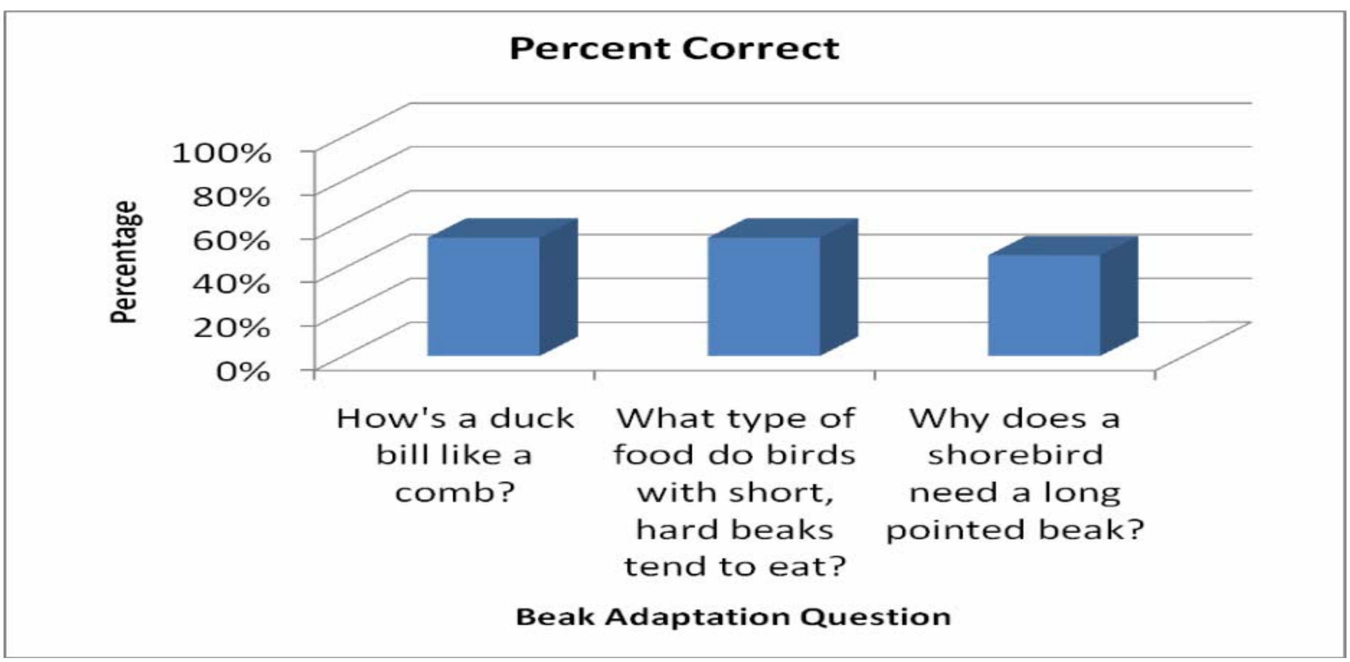

Figure 32: Percentage of Correct Responses from Public 5th Graders

Compared to the previous classes, the consistency in which they scored showed an improvement in comprehension. Throughout the course of our 8 school visits it is clear that the prototypes were able to teach their lessons quite successfully and with little need for explanation other than the provided text. As the prototypes were refined it was shown that the comprehension of the associated exhibits increased as well.

5.1.2.3 Bird Feet Adaptation

The Bird Feet Adaptation prototype was derived from the same exhibit in the Museum of Science in Boston as the Bird Beak Adaptation Prototype. As mentioned previously with the Bird Beak prototype, adaptation was a topic taught by the fifth grade teachers. The lessons taught in the prototype cover multiple Massachusetts Curriculum Frameworks for grades K-5. These frameworks include K-2 Life Sciences: Characteristics of Living Things (Learning Standard No. 1) and 3-5 Life Sciences: Characteristics of Living Things (Learning Standard No. 1 and No.6) see Appendix K.

5.1.2.3.1 Evaluation

The evaluation process for this prototype consists of a series of tests and revisions. We organized school visits with classes from kindergarten to fifth grade so that we would have children to test the prototype. During their visits, a tour was provided and the students were allowed to interact with the prototype as we observed them. We looked for certain interactions, most notably: reading labels, asking questions, explaining concepts, and manipulating the prototype. After their tour and testing the prototype, through interaction, children who could read and write answered questions in “investigation packets” that we provided them. These were also surveys distributed at the end of the visit to gauge how comfortable visitors were the prototype and whether they enjoyed themselves.

Changes were made to the prototype based almost entirely on observations during these visits. In some cases, survey data collected from the visits and data from the investigation packets also factored into our modifications to the prototype.

5.1.2.3.1.1 The Lighthouse School

In the case of our first school group, from the Lighthouse School, all changes were based on observations. After their visit, we determined that revisions needed to be made. The main one was to remove the branch handle from the staple remover for the water habitat display because the tape loosened in the water. Also, the text on the label was unclear. It originally read as follows:

> Webbed feet are an adaptation to allow ducks to move on the water faster. This is due to the increased amount of surface area a webbed foot has compared to the typical 4 “toed” feet of other birds, like hawks. The 4 “toed” feet of most birds allow them to perch on tree branches out of the reach of ground predators. Birds of prey also use the talons on the end of their toes are also used to tear at their food.
>
> Feel the difference. The wider spatula pushes more water than the smaller, curved staple remover. Which do you think represents the duck’s webbed feet? Why?

We quickly corrected this by crossing out the part that made little sense immediately after setting up. The last sentence of the first paragraph was edited so that it would form a complete thought for the next group at the end of the day. We also split the label by habitat so that there would be one for the perch and one for the water. Breaking up the text would create more incentive to read the labels. The water label now read:

> Webbed feet are an adaptation to allow ducks to move on the water faster. This is due to the increased amount of surface area a webbed foot has compared to the typical 4 “toed” feet of other birds, like hawks.

> Feel the difference. The wider spatula pushes more water than the smaller, curved staple remover. Which do you think represents the duck's webbed feet? Why?

The label for the tree perch habitat was extracted from the larger, original label. The same information was used from above but new instructions were written. The old instructions neglected the perch experiment altogether. After being reworked, the second label read as follows:

> The 4 "toed" feet of most birds allow them to perch on tree branches. This keeps them safely out of the reach of ground predators. Some birds also have talons at the end of their toes which can be used to tear at food.
>
> Try using the staple remover like a bird foot and grip the branch. Then try using the spatula. Which works better?

Another major observation that we made was that the upper branch used as a part of the perch habitat was too large in diameter for the staple remover claw to effectively grip around it from all angles. When we originally tested the prototype ourselves, before bringing the children in to test it, we found that the staple remover worked well in the section we tried. When children came in, they tested it in areas that were too large for the tool to fit around. This was corrected later that night by finding a new, slimmer branch to use.

Due to the difficulty with reading, the kindergarten class did not proceed with the investigation packets or surveys. We also needed to explain the concepts in the prototypes more and read the labels to them. The tables were generally slightly too tall for them to properly manipulate the prototypes. The children could also barely see the current exhibits and displays in the bird room due to height.

The second group to come in consisted of first and second graders. No changes were made based on observations between this group and the preceding one. The major changes were that, since roughly half of the students could read, they were less focused on explanations of the prototypes. Unfortunately, they were not proficient enough readers to be able to understand the text fully or to even read it effectively. Because of this, the prototype needed to be explained to them as it was for the kindergarten class. Two questions from the packet related to this prototype. The data collected from them are shown below (see Figures 33 and 34).

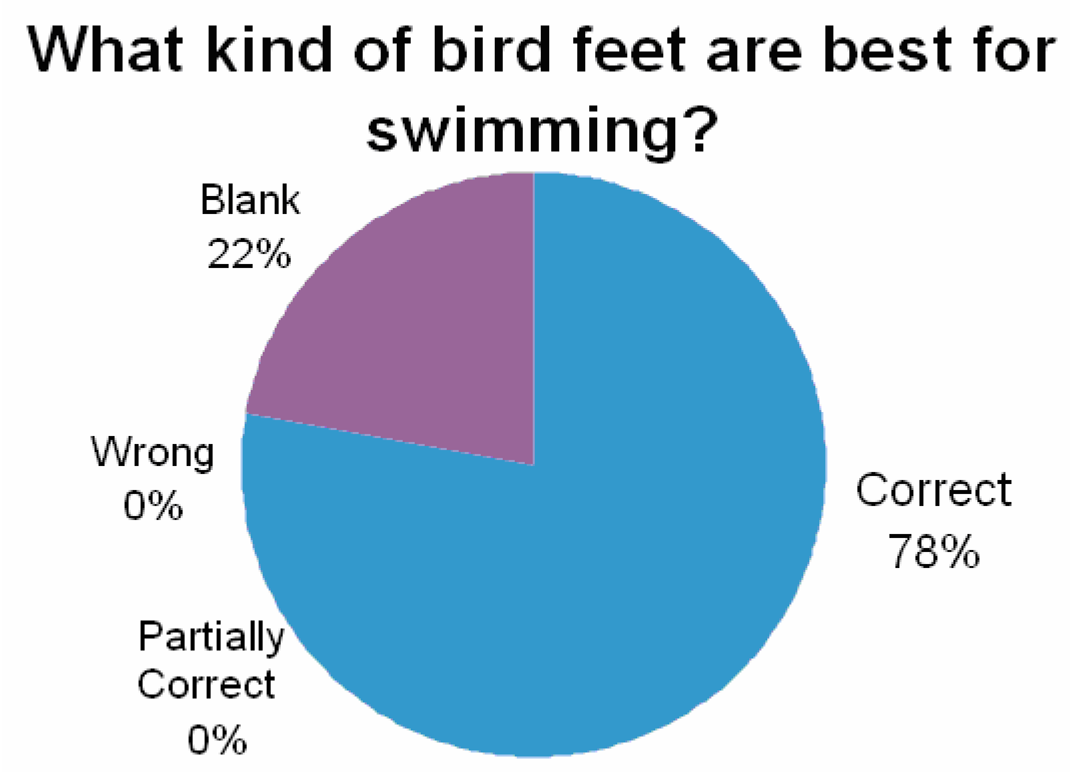

Figure 33: Response Breakdown for Webbed Feet Question

As the above chart shows, there were only two types of responses to this question. The children either answered correctly or left it blank. This was most likely caused by time restraints and problems reading. Some of them could read and some of them could not. Due to this, our investigation packets were more difficult for them to complete than any other group. They also had no extra time to complete our survey. Despite these difficulties, the data still shows that nearly eighty percent of the students understood that webbed feet were best adapted for swimming.

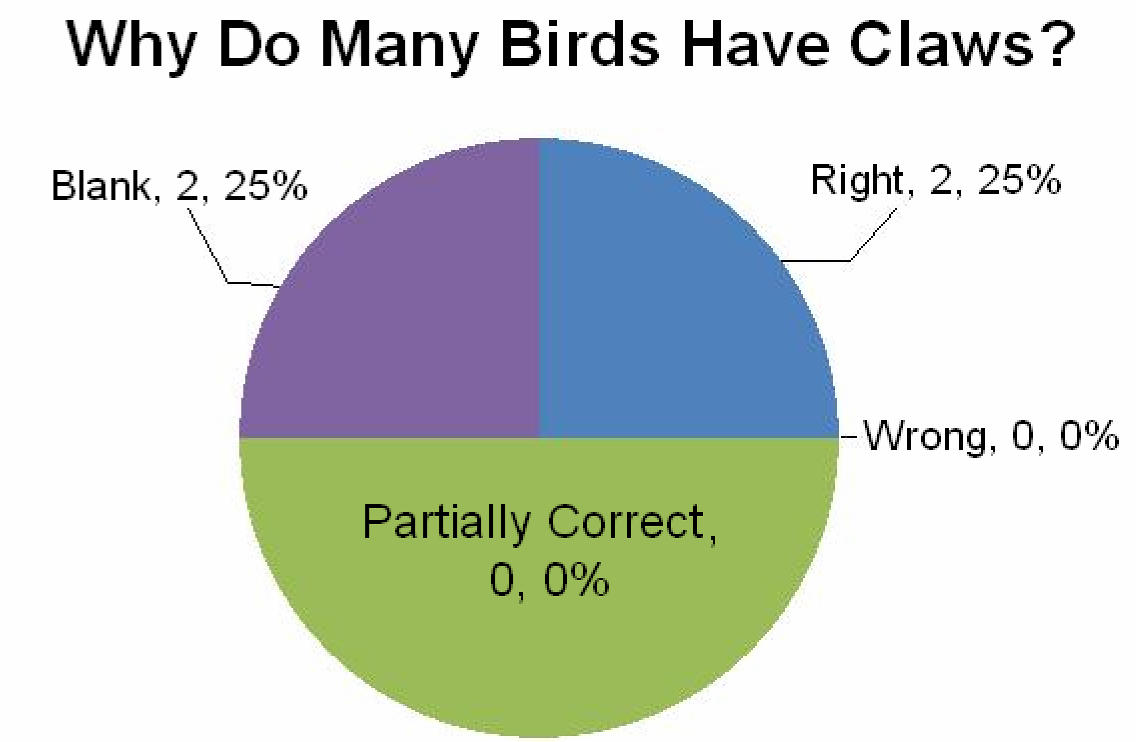

Figure 34: Response Breakdown for Bird Claw Question

This question received the least correct answers of all our claw/foot data thus far. The four somewhat correct answers are below.

Table 6: Partially Correct Response Chart for Bird Claw Question

Why do many birds have claws?	So they can catch prey
	To catch stuf [stuff]
	To cach [catch] here [their] pr [prey]
	To catch pray [prey]
	So they can kill pray [prey]

All of these answers are about predatory birds and catching prey. The answers that were considered correct mentioned grasping onto branches. In the prototype, the students were asked to grasp onto a perch using a staple remover. Because the prototype made no mention of catching prey, we suspect that this answer came from prior knowledge. If this is true, then the prototype did not teach the children who gave somewhat correct answers about claw adaptations in relation to a perch setting.

The last group from the Lighthouse School consisted of third, fourth, and fifth graders. They were all able to answer the investigation packets and survey at the end of their trip. One of the surveys says that the child is in sixth grade despite the fact that, to our knowledge, the Lighthouse School only teaches up to the fifth grade level. Despite this, the rest of the data is relatively sound.

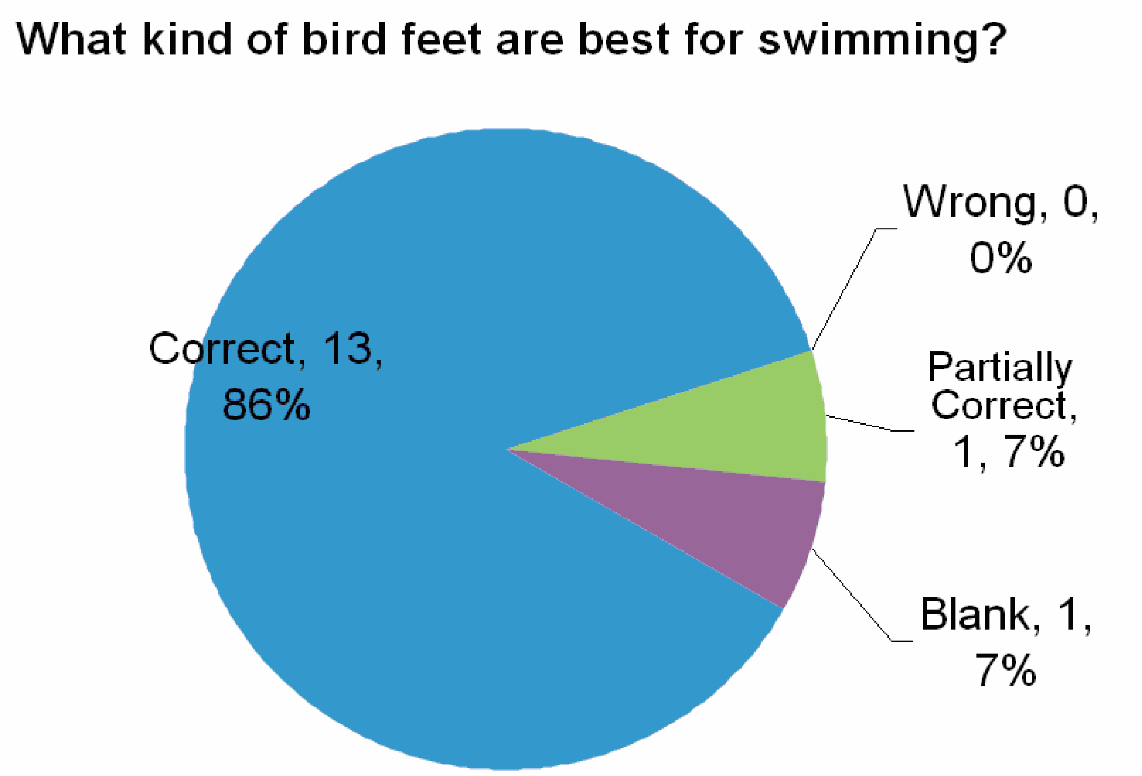

Figure 35: Response Breakdown for Webbed Feet Question

In this group, the majority of the responses, over eighty percent, were correct. One was left blank and one was somewhat correct. The somewhat correct answer said that duck feet are best adapted for the water, which is correct. The student goes on to say, however, that this is because ducks and penguins live near the water. Although this is true, the answer does not reflect the design of the duck's foot, which is what the exhibit was meant to display and explain. Of the thirteen correct answers, nine mentioned webbed feet directly. The other four named birds such as ducks and penguins that have webbed feet.

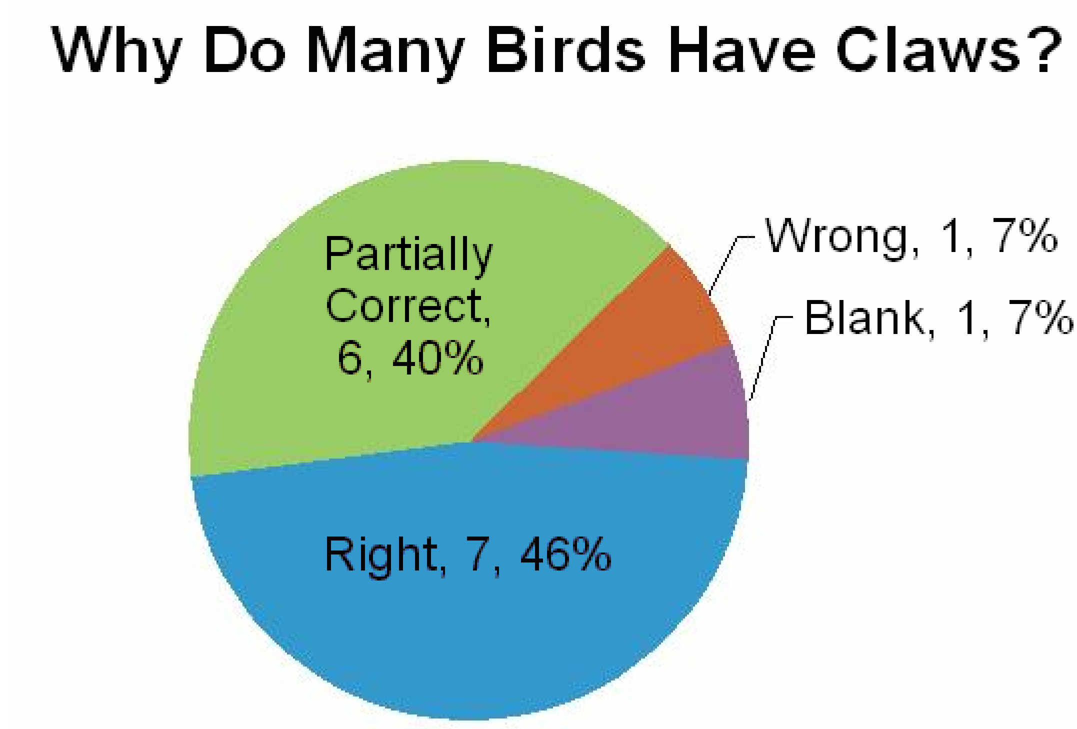

Figure 36: Response Breakdown for Bird Claw Question

Nearly half the class answered this question correctly. The answers were only considered correct if they mentioned perching or grasping onto branches. One student refused to answer and another answered completely incorrectly, stating that birds had claws "to take away meditors [predators]." Not only did the student not use the prototype as a basis for his or her answer but the child also believed that claws were a defense mechanism to prevent attacks from predators. The answers that fall into the somewhat category focused on a different function of bird claws, more specifically, talons. The somewhat correct answers are presented in the following table.

Table 7: Partially Correct Response Chart for Bird Claw Question

Why do many birds have claws?	To catch things
	To grab their food
	So they can catch there [their] pray [prey]
	So they can cetch [catch] fish and mice
	To catch there [their] pray [prey]

	To perch on branches and dig out food

This table demonstrates that, much like the first and second graders from the Lighthouse School, six children from this class group believed that claws were only used for catching or eating prey, even though the prototype did not directly demonstrate this concept. In addition to this, many of the answers considered right for this question mentioned prey as well.

Table 8: Correct Response Chart for Bird Claw Question

Why do many birds have claws?	To grip on to prey and branches
	To grab prye [prey] and brantshes [branches]
	To hang on to branches
	To catch there [their] prae [prey] and grasp on to trees
	To grasp on to branches and to catch prey
	To perch and hunt
	Because they are carnivorous and need to grip branches

There is only one response that did not mention birds of prey. This is strange because although birds of prey were mentioned briefly in the label, the use of talons to catch or eat prey was not promoted in the prototype design. Nowhere in the prototype did a student catch any prey. The prototype solely displayed claws grasping onto branches. This has led us to believe that the students answered based on prior knowledge which was then reinforced by the brief mention of talons on the label.

Overall, the Lighthouse School seemed to have a decent understanding of the webbed foot and claw adaptation prototype. There is a trend that the younger children did not understand as much as the older classes did for both the webbed foot and the claw portions. This trend may be seen in the graphs below.

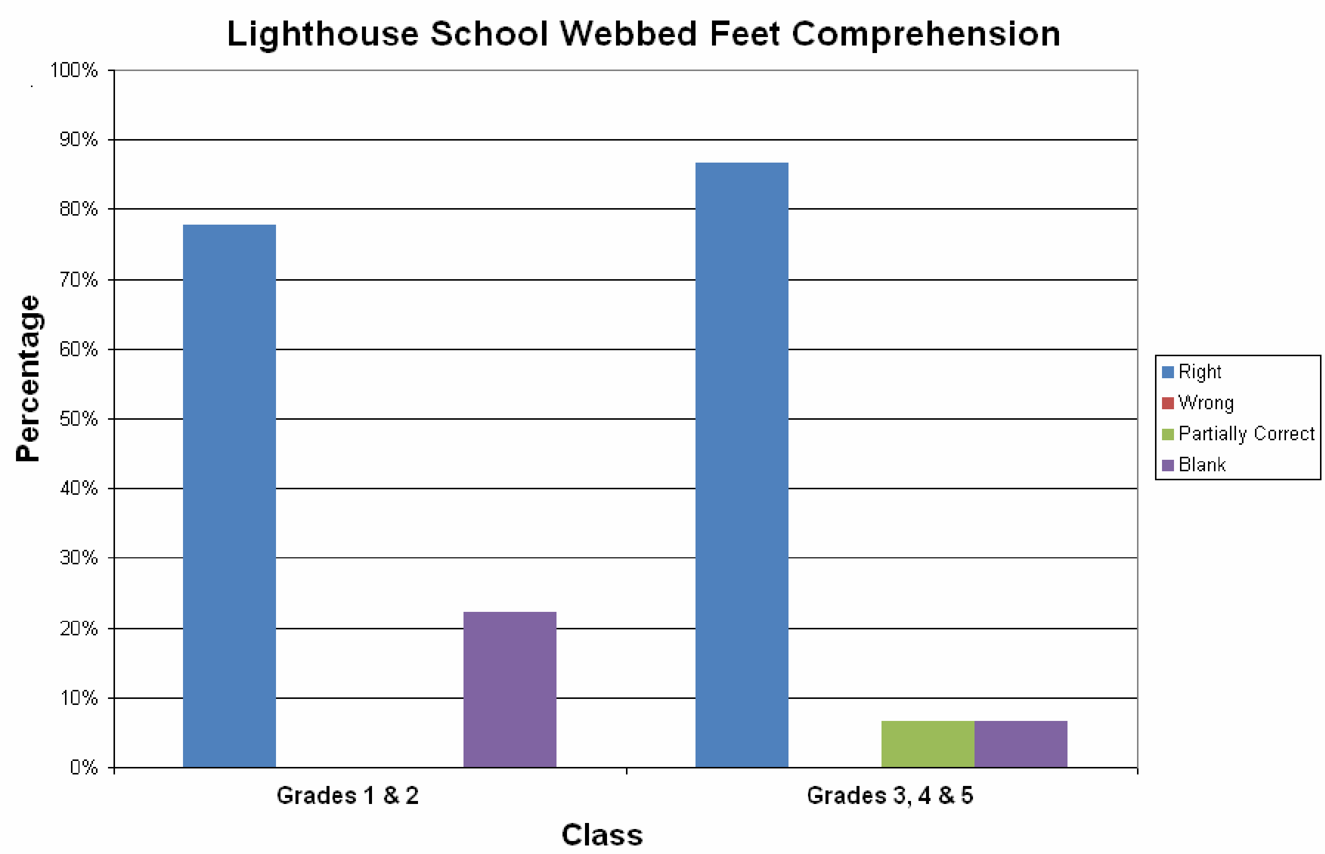

Figure 37: Lighthouse School Webbed Feet Comprehension

In each group, at least 78% of the students were able to tie the spatula demonstration to the actual application of webbed feet on aquatic birds. Fewer students were able to connect the staple remover to the claws of non-predatory birds, as shown below.

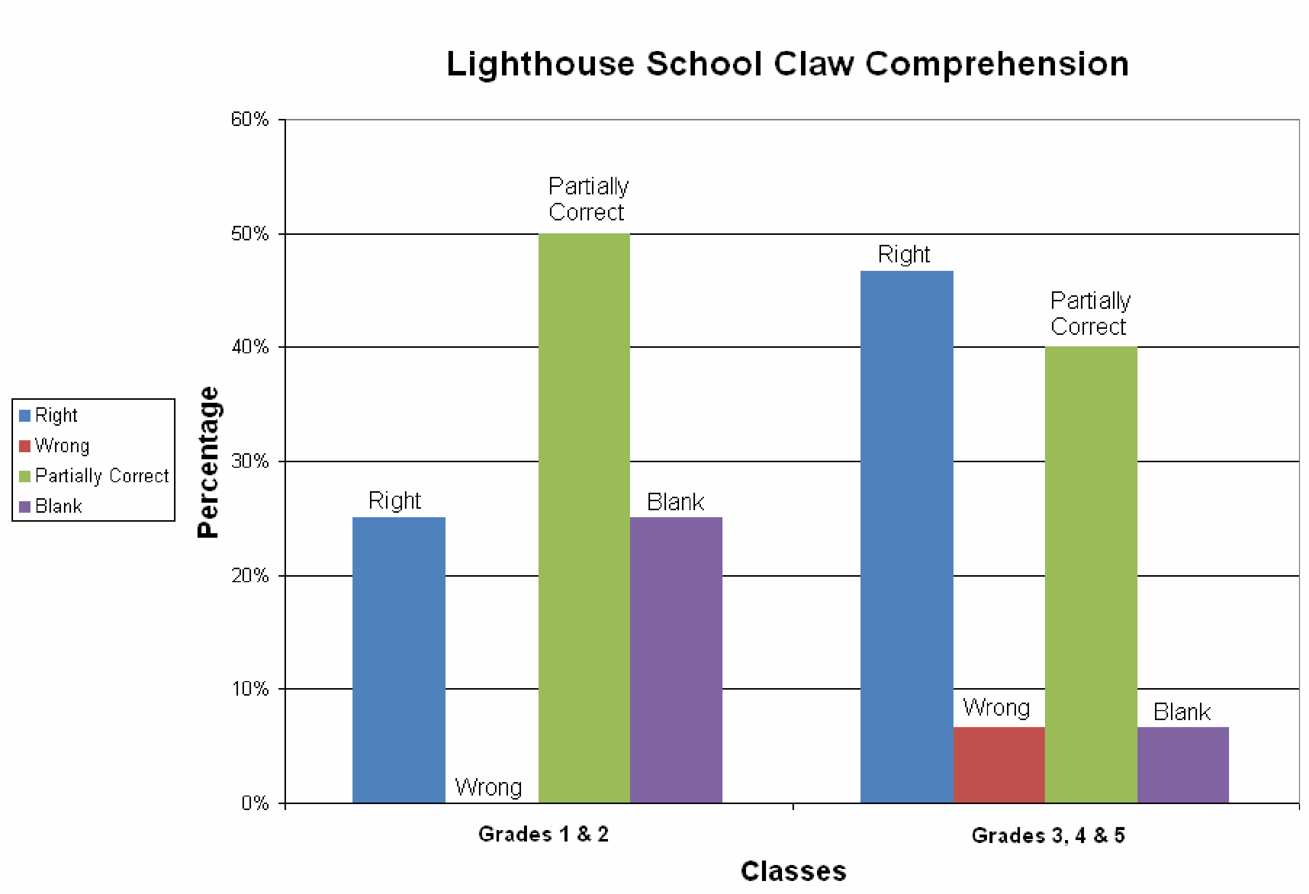

Figure 38: Lighthouse School Claw Comprehension

More specifically, it was clear that the older grades understood the prototype more than the lower grades. There were considerably fewer blank responses from the third, fourth, and fifth graders. It is also clear that there were more correct answers from the older group than there were from the first and second graders. This shows a trend that continued as more school groups visited the museum.

5.1.2.3.1.2 Nantucket Elementary School: Mike Girvin's Fifth Grade Class

This prototype was tested again, two days later, when Mike Girvin brought his fifth grade class to the museum. During our observations, we noticed that the children were more engaged and interested than the previous groups had been. More specifically to the prototype at hand, the students were trying to peel the bark off the perch with the staple remover rather than wrap the claw around it. We did not make any changes to it based on this however, because it might have been an isolated incident. Only a handful of students made this mistake. Another observation is that students began to mix up the tools as soon as they determined which one was best for which habitat. For example, once the children discovered that the webbed foot is better adapted for the water, they used both spatulas in the water rather than trying one in the water and one on the perch as we had designed it for them to do. This was not changed either because we felt that we needed more data before eliminating the second set of tools.

Although this class was able to answer the investigation packet questions and the surveys for us, these data did not directly affect the changes made to the prototype. This was mostly because, despite the observations made about this class above, they displayed a good understanding of the topics presented in the prototype.

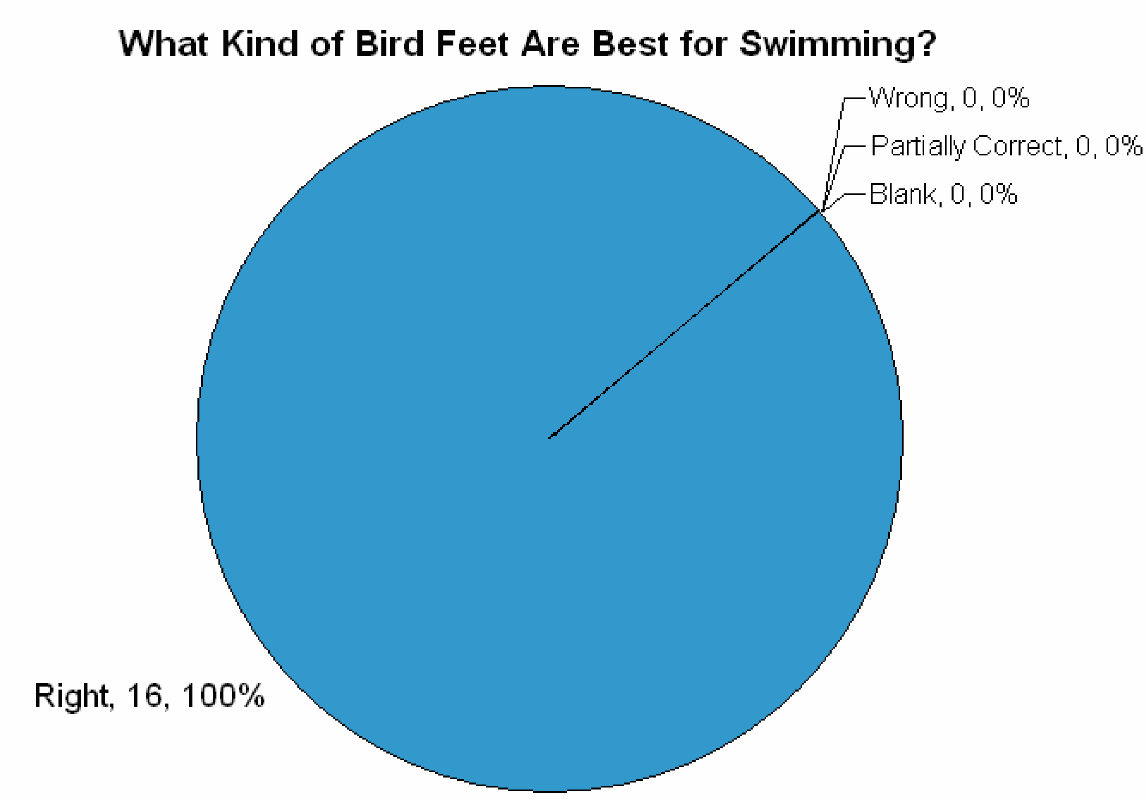

Figure 39: Webbed Feet Response Breakdown of Mike Girvin's Class

This chart demonstrates the level of understanding of the water habitat adaptation of webbed feet. Every single student in this particular class understood that webbed feet were best adapted for the water and for swimming. The chart is broken up into the four categories that we created for evaluating comprehension from the packets. The answers that we considered right needed to say that webbed feet were better for swimming. The somewhat category would include answers that did not include any mention of webbed feet or duck's feet but the concepts behind them such as increased surface tension or being built to push the water away. The "wrong" category would include any answer that had nothing to do with webbed feet, duck's feet, increased surface tension, or pushing the water away.

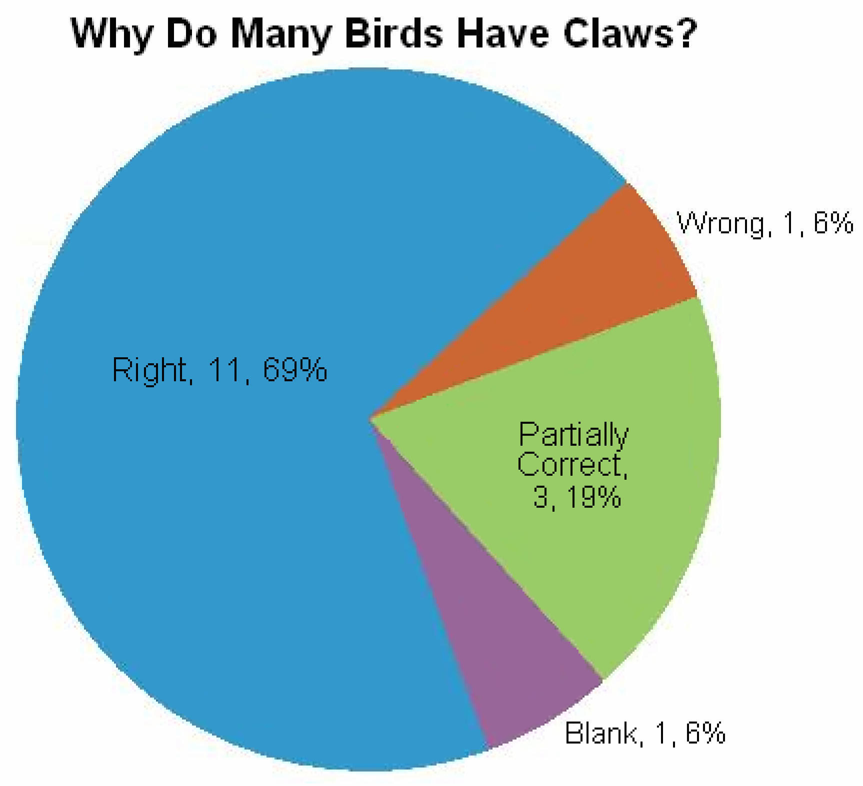

Figure 40: Bird Claw Response Breakdown for Mike Girvin's Class

This pie chart represents the class's understanding of the perch habitat, using the data extracted from the investigation packets. Nearly seventy percent, a good majority, of the students were able to grasp this concept. Only one child left the question blank and another got it wrong. Three children were almost correct, falling into the somewhat correct category. Their responses are presented below in Table 9.

Table 9: Partially Correct Response Chart for Mike Girvin's Class

Why do many birds have claws?	to catch and kill there [their] prey
	to cech [catch] there [their] pray [prey] or eat there [their] pray [prey]

	so they can hold on there [their] Fray [prey]

These responses were considered somewhat right because they did not mention the answer that we were anticipating, which was that birds have claws to allow them to grip onto branches and perch. Instead, these responses were true but focused on another benefit of claws, more specifically talons: catching and eating prey. In fact, out the eleven correct answers, six mentioned perching as well as catching prey. The other five mentioned only perching. This was a common trend based on their prior knowledge of birds of prey as well as its mention on the label. Even though this prototype did not demonstrate the use of talons in catching prey, students still consider it a main function of claws.

5.1.2.3.1.3 Nantucket New School Third Grade Class

During the third week of observations, we worked with the Nantucket New School. The class contained about thirteen students. The perch label was changed before this group came in from “grip the branch” to “grip around the branch.” This led to fewer students scratching the bark off the branch and better demonstrated the grasping ability of bird claws. Our observations showed that these children were more excited than many of the previous groups to be in a museum setting. In general, however, this class was not interested in reading. On many occasions, we needed to encourage the students to read the labels.

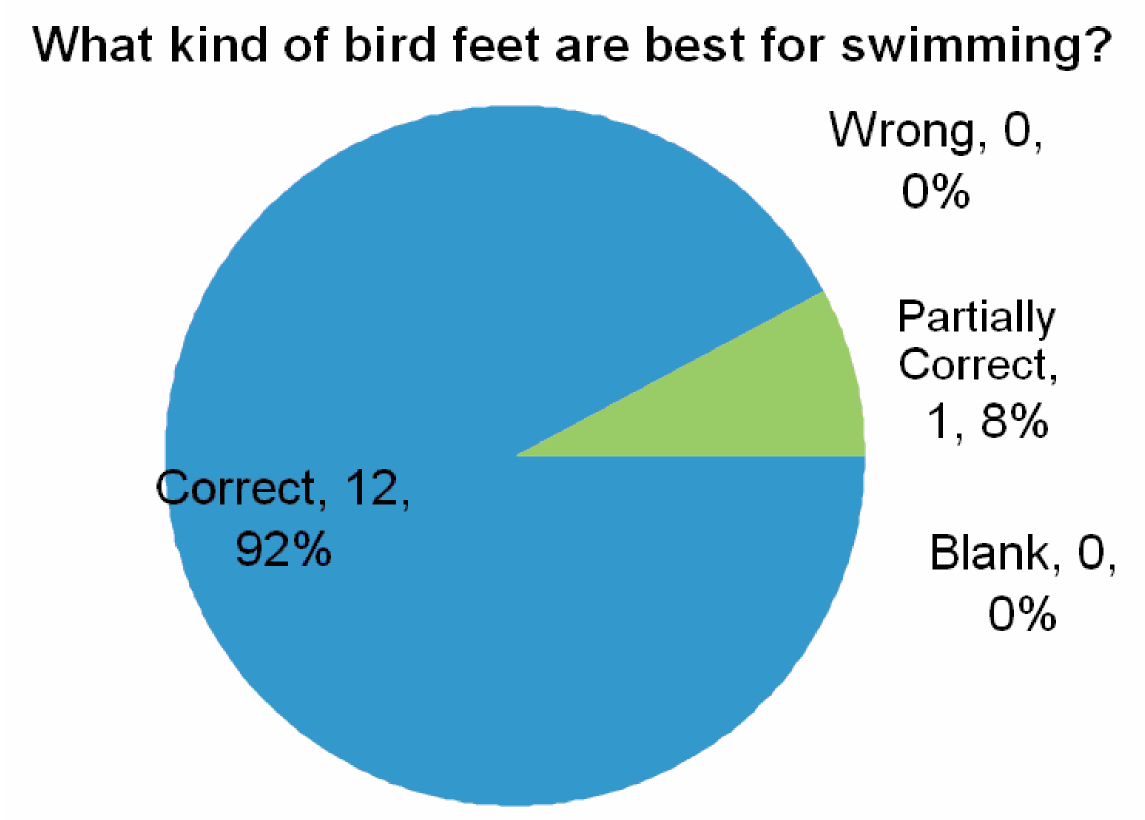

Figure 41: Webbed Feet Response Breakdown for New School Class

In response to this question, all but one student answered correctly. The child who was somewhat correct wrote, "Duc[k] feet, I think." This answer is only somewhat correct because of the uncertainty with which the child answered the question. The correct answers were more certain, as the table below illustrates.

Table 10: Responses for Webbed Feet Question for New School Third Grade Class

What kind of bird feet are best for swimming?	web[b]ed feet
	web feet
	webed [webbed] feet
	webed [webbed] feet or duck feet
	duck feet
	ducks feet are the best for swi[m]ming
	webbed feet are best for swimming

	webbed feet
	flat feet like ducks
	webed [webbed] feet
	duck feet
	webbed feet

Of the twelve correct responses, eight of them named webbed feet specifically as the bird foot best adapted for swimming. The other four mentioned ducks, most likely because the label used ducks as an example of birds adapted to live in or near the water. One stated that duck feet are best adapted for the water because they are flat, likely making a connection to the increased surface area of webbed feet. This concept was also mentioned in the label. Such a high percentage of correct answers proves that, overall, this class was able to understand that webbed feet are best adapted for the water.

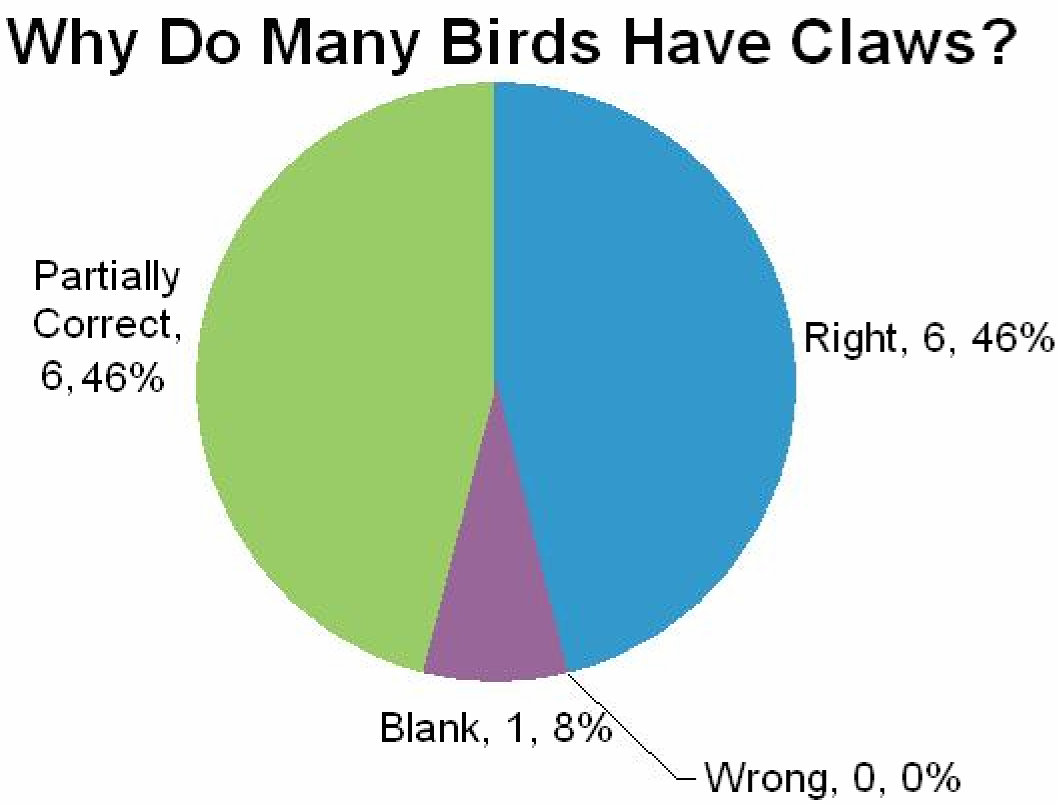

Figure 42: Bird Claw Response Breakdown for New School

The majority of students showed a reasonable understanding of the reasons why birds have claws. One child left the question blank. The same number of students responded correctly as those who answered partially correctly. Both categories of answers are shown in the figures on the following page.

Table 11: Correct Responses for Claw Question from New School Third Grade Class

Why do many birds have claws?	to stay on the trees
	for holding on to branches
	to lach [latch] on to tree and catch there [their] pray [prey]
	so the [they] and [can] grab onto mice and grab onto branches
	so they can hold onto branches
	to cling on trees and branches
	so they can hang on to trees

The answers shown above are considered correct because they mention the function of bird claws that was demonstrated in the prototype. Two of them also point out other functions of such claws as well.

Table 12: Partially Correct Responses for Bird Claws Question from New School Third Grade Class

Why do many birds have claws?	to cary [carry] stuff that they eat
	to carry stuff that they eat
	because they live in trees
	to catch their prey
	to rip there [their] food apart

These answers are considered somewhat correct because they were not a part of the physical prototype. The goal of this study is to prove that manipulating a hands-on exhibit will strengthen a child's understanding of the concept being taught. These answers do not prove that they manipulated the prototype or learned from it. Instead, it suggests that they answered based on prior knowledge.

Table 13: Bird Feet Observation Data from New School Third Grade

Glanced at	13
Read exhibit labels	10

Ignored	0
Pointed at	13
Asked questions about	4
Explained	5
Manipulated	10

Observation data supports this suggestion. Of the thirteen students, all of them looked at the prototype. Ten of them read the labels. Ten also manipulated the prototype. Five students were able to explain why webbed feet were more effective in the water than claws or why claws are good for perching. In general, children who manipulated the prototype and read the labels were able to explain the concepts readily. The five who explained the adaptations were likely to respond correctly to the question "Why do many birds have claws?"

Table 14: Pro-prototype Responses from Prototype End Survey from Nantucket New School

Which exhibits would you like to remain in the Natural Science Museum?	Bird claw exhibit, bird claw exhibit
	The bird beak exhibit and the claw exhibit. I think they should all be in the Science Museum!
	The room [where] all the thing are alive and the bird room
	I would like to stay in the Bird claw ex[h]ibit.
	The one with live animals and the one with all the stuffed birds.
	The bird exhibit and the exhibit with live stuff in it.
	I do not [k]now at all. I Love all of them so I can not cho[o]s[e] 1 of them.

After collecting thirteen surveys from the students, seven of them mentioned the prototypes in the bird room in some form. Three of these seven, mention the bird claw exhibit specifically. The survey answers are a measurement of how much the children enjoyed the prototypes in relation to the other exhibits within the museum. The entire document may be found in Appendix D-4. From this, we gather that most of the students were very happy with the bird claw prototype and are looking forward to seeing it in the Natural Science Museum in the future.

5.1.2.3.1.4 Boys and Girls Club

A small group of six children from the Boys and Girls came in on the same day as the Nantucket New School third graders. The prototypes were set up in the main room instead of the Bird Room and the Marine Room, respectively. This change was made because of time constraints. They were the only group not to receive a tour of the museum. Only one change was made to the prototype for this group. Rather than leaving two sets of tools out for the water and perch habitats, only one set was left on the display table. Prior groups tended not to pay as much attention to the instructions for one half of the prototype when there were two sets of tools available. Also, it is more realistic that smaller groups would be visiting the museum as families so multiple tools would not be necessary for that type of setting. With just one set, generally children were better able to focus on testing one half of the prototype before trying the other.

This group was harder to lead because they were of mixed age. Only two children felt comfortable reading the labels aloud. A few questions were asked while testing the prototype. When asked why they thought that the spatula worked better in the water than the staple remover, one of the children answered that the metal in the staple remover was heavier than the polymer in the spatula. The fact that this child was answering the question by referring to differences in the materials used highlights the fact that he was unable to see the analogy right away. He was unable to connect the tools to the actual adaptations that they were meant to represent.

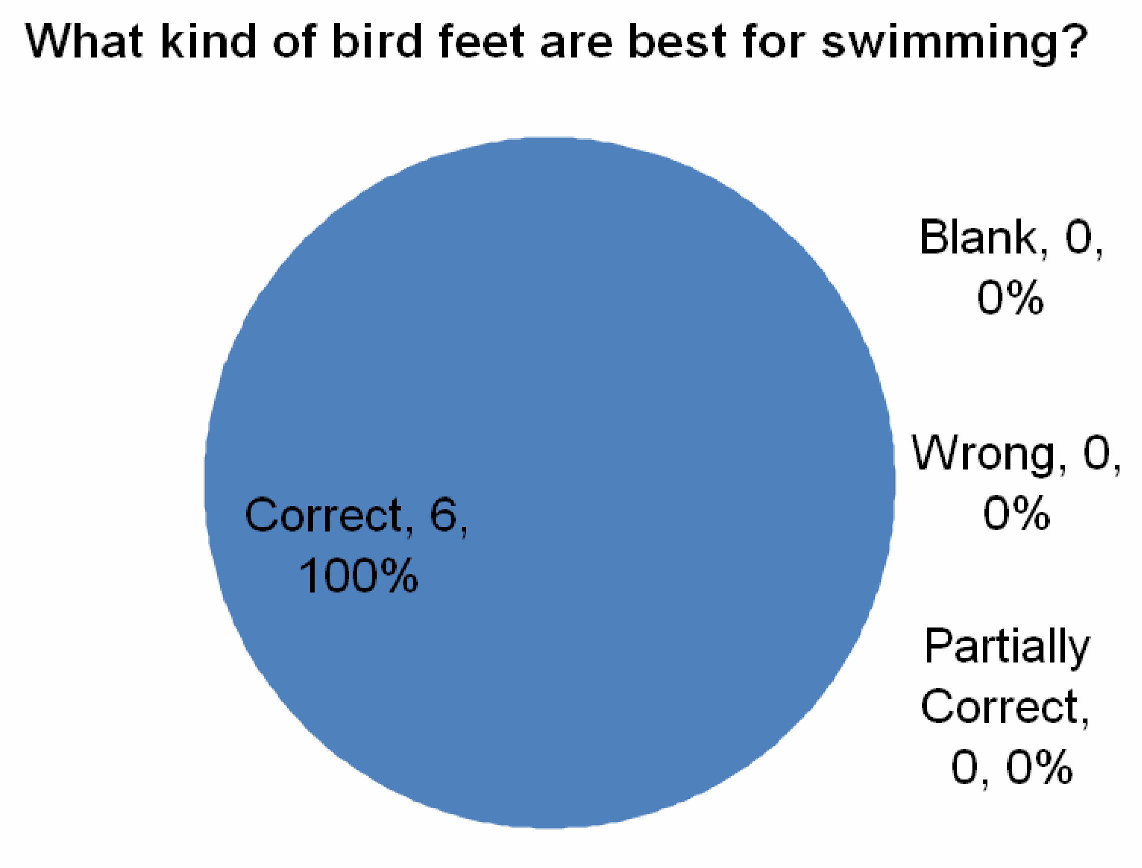

Figure 43: Webbed Feet Response Breakdown for Boys and Girls Club

Despite the confusion mentioned above, all six of the children answered this question correctly. In the responses, no one mentioned material differences. Each child mentioned that duck feet, webbed feet, or flat feet were better adapted for the water than bird claws as shown in the table below.

Table 15: Webbed Feet Question Responses from Boys and Girls Club

What kind of bird feet are best for swimming?	webbed and capped [cupped]
	flat
	wedded [webbed]
	buckfeet [duck feet]
	buckfeet [duck feet]
	flat

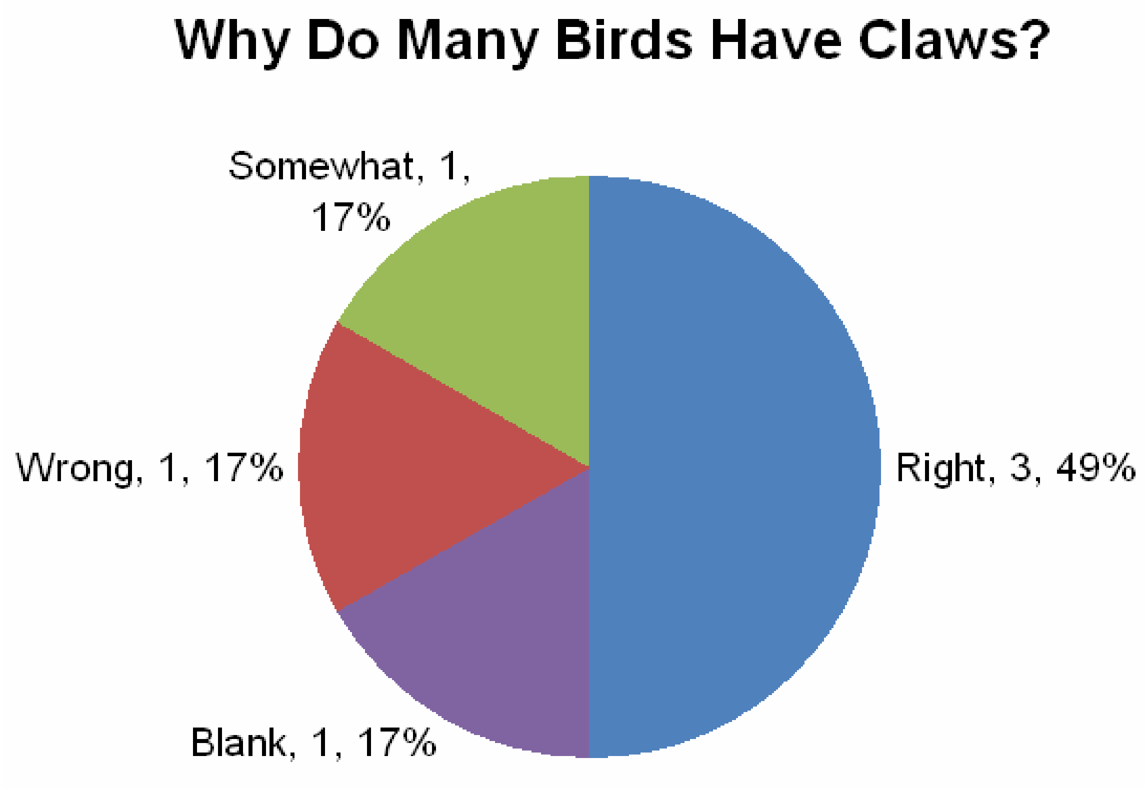

Figure 44: Bird Claw Response Breakdown for Boys and Girls Club

Only half of the students were able to correctly answer the second question related to this prototype. This was most likely because of the difficulty that many children had with reading.

Table 16: Responses for Bird Claw Question from Boys and Girls Club

Why do many birds have claws?	?	Blank
	pick	Wrong
	pick up thiings [things]	Partially Correct
	to hang on branches	Right
	to howld [hold] onto trees	Right
	to sit up on tree's [trees]	Right

The survey data below suggests that only two children were actually proficient in writing and one was interested in seeing the bird foot adaptation exhibit in the future. Another was very excited to see all of the prototypes as well as live animals. The other students left this question blank.

Table 17: Responses to End Survey from Boys and Girls Club

Which exhibits would you like to remain in the Natural Science Museum?	Claw
	I would like a lot of them. Real birds and snakes too.

5.1.2.3.1.5 Nantucket Elementary School: Janet Brannigan and Kara Carlson's Fifth Grade Classes

On Monday and Tuesday of the week following the Boys and Girls Club visit, two more fifth grade classes tested our prototypes. The first class was Kara Carlson's, which had eighteen students. Overall, they were difficult to control. This is partly because they were a large group but also because they were less interested in the educational aspect of the trip and more interested in socializing. Due to the large size of the group, the students were split into two groups of nine so that a smaller group of students would be able to focus on each prototype. There were students, however, who were more open to learning. This is reflected in the following observational data.

Table 18: Observations Made for Feet Adaptation Prototype

Feet Adaptation Notes	First group didn't read labels
	First group: 4 didn’t manipulate & 4 read
	Second group participated learned
	Most students manipulated prototype

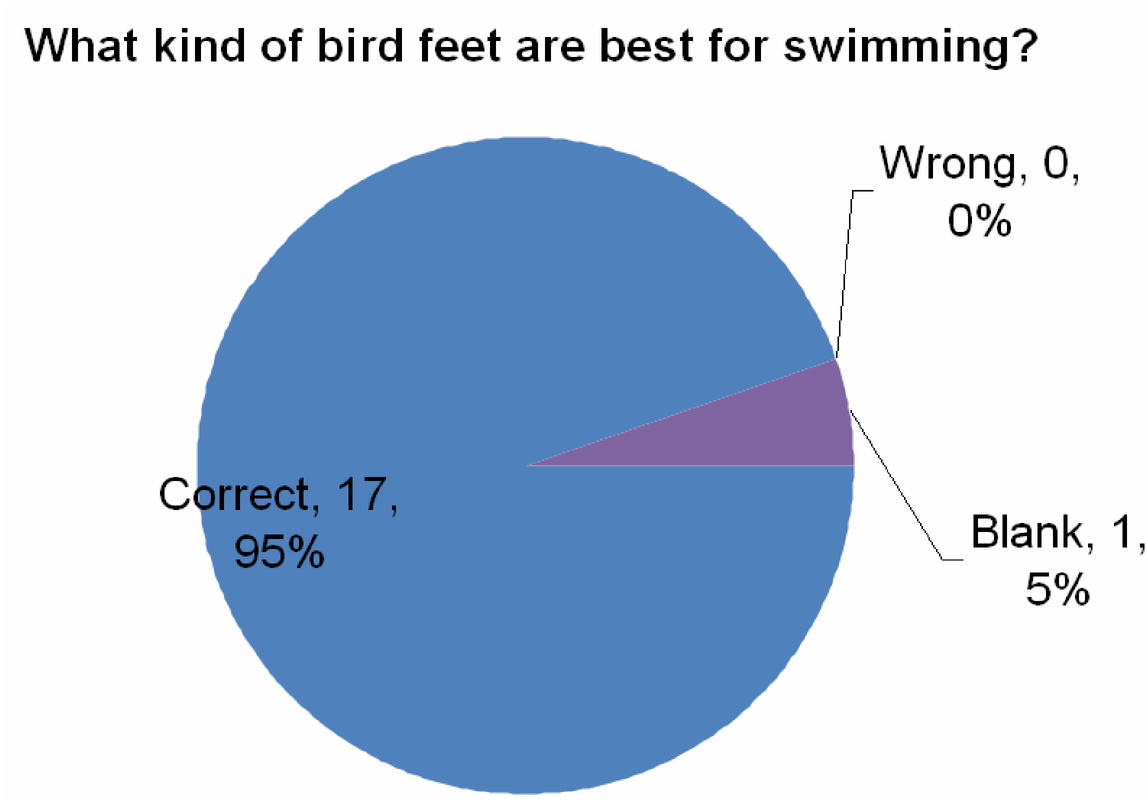

Figure 45: Webbed Feet Response Breakdown for Public School 5th Grade Classes

In response to the question above, nearly all of the students answered correctly, which demonstrates that ninety-five percent of the class understood that webbed feet are better adapted for the water than the alternative.

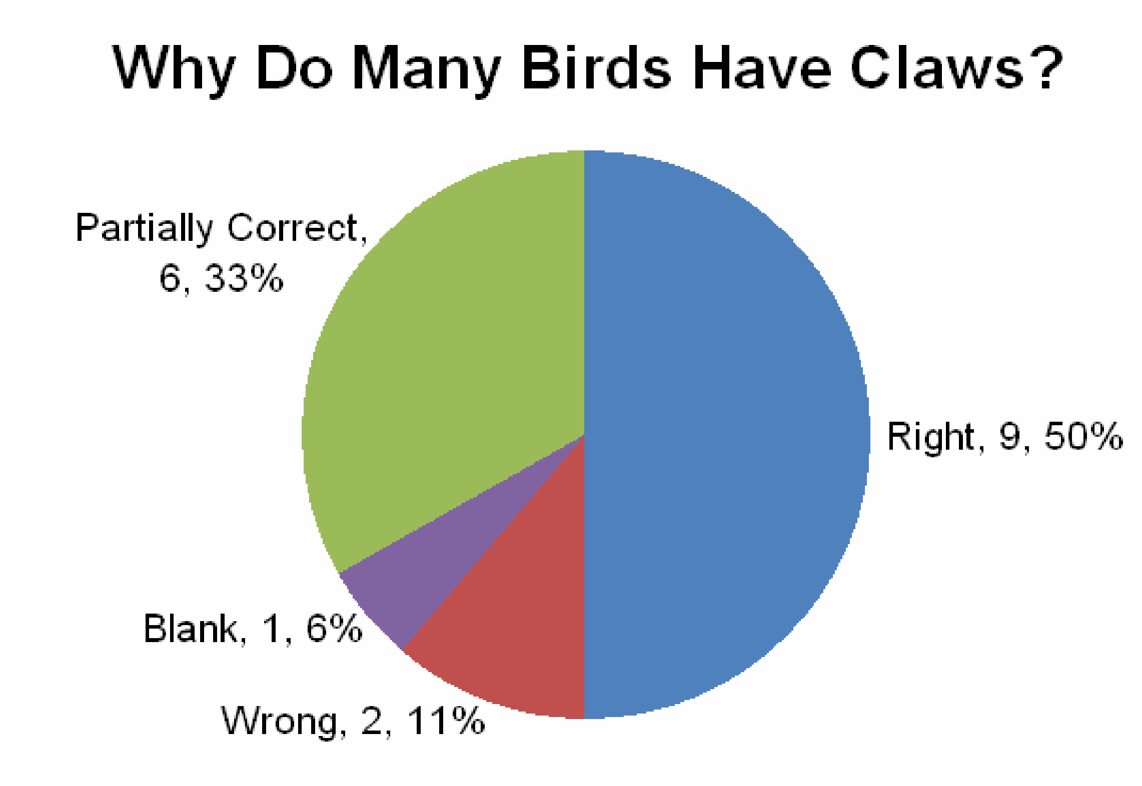

Figure 46: Bird Claw Response Breakdown for Public School 5th Grade Classes

Half of the same class answered this question correctly. Observations showed that this could be due to the fact that hawks are listed on one of the labels as having clawed feet. The students may have taken that into account when providing answers for this question.

The following tables present the partially correct responses and the incorrect answers, respectively. All of the partially correct answers are about birds of prey or catching food, which was not an active part of the prototype.

Table 19: Partially Correct Responses to Bird Claw Question Nantucket Elementary School Kara Carlson's Class

Why do many birds have claws?	they need claws to grab food and other things
	to eat there [their] prey
	to grab
	to grab things of [off] the grown [ground] and to protect them silf [themselves]
	to grab there [their] food
	to grab or catch their dinner

Table 20: Incorrect Response to Bird Claw Question Nantucket Elementary School Kara Carlson's Class

Why do many birds have claws?	to help them swim or walk
	very little

Janet Brannigan's class of sixteen students also came into the museum. This class was very cooperative, despite their relatively large class size. Much like the previous class, the students were split into two groups of eight so that a more focused group of students would be able to work with each prototype. Before this class entered the museum, the label was changed further so that it did not mention birds of prey. This can be seen in Appendix H-5.

Table 21: Observations Made at Feet Adaptation Prototype for Janet Brannigan's Class

Feet Adaptation Notes	One girl started reading label as soon as she entered the room, very interested
	Two girls sat in corner, didn't interact/manipulate
	Second group usually more restless than first
	Students already understand concept
	Two people pointed out only perching birds, without mentioning birds of prey
	One student explained increased surface area by using a swimming analogy

Most of the children were very eager to learn. This is reflected in the preceding observational data. It seemed that the testing period went too long for this group because they understood right away the differences in the design of the webbed foot and the clawed foot.

Table 22: Observations Made for Feet Adaptation Prototype for Janet Brannigan's Class

Glanced at	16
Read exhibit labels	10
Ignored	2
Pointed at	8
Asked questions about	5
Explained	9
Manipulated	11

The numerical data above further supports the observational notes in the previous table. A high number of students, eleven out of sixteen manipulated the prototype and nine were able to explain the reasons why webbed feet are more effective in the water and claws are adapted for perches after reading the label.

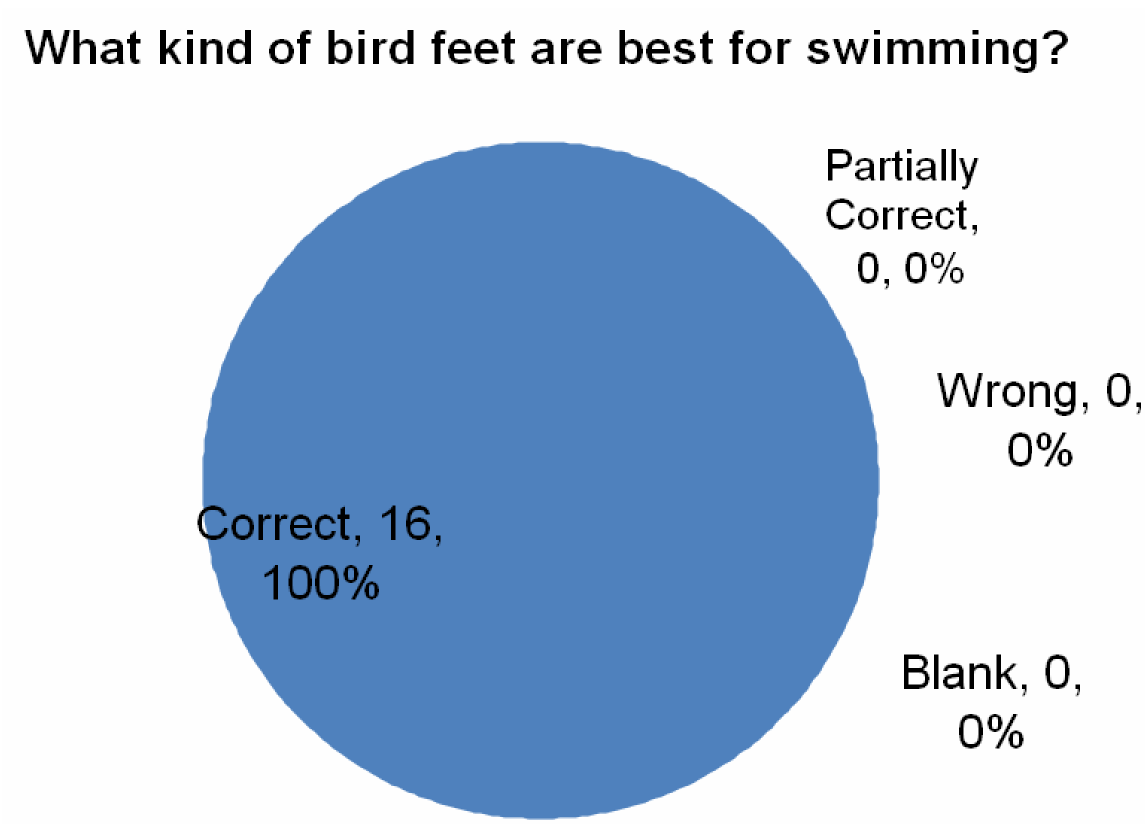

Figure 47: Webbed Feet Response Breakdown for Janet Brannigan's Class

There was not a single student in Ms. Brannigan's class who answered this question incorrectly. This proves that the entire class displayed a good understanding of the reasons why webbed feet are adapted for swimming.

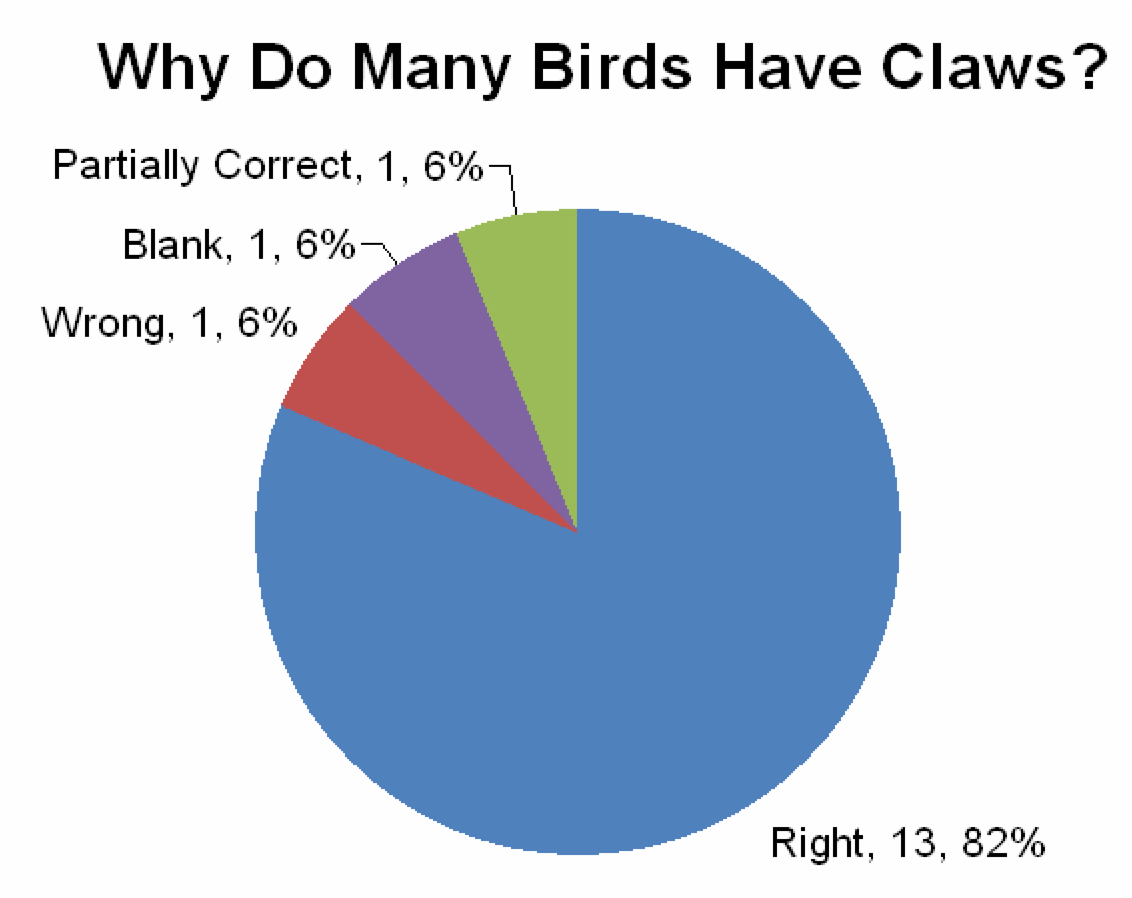

Figure 48: Bird Claw Response Breakdown for Janet Brannigan's Class

This class had the highest percentage of correct answers to this question. This likely indicates that the changes made to this prototype over the other test groups made it easier for the students to learn from the prototype. Also, the following were the only answers that mentioned capturing prey or catching food. The two answers that were wrong or partially correct are presented in a table below.

Table 23: Partially Correct and Wrong Responses to Bird Claw Question from Janet Brannigan's Class

Why do many birds have claws?	so they can dig for food	Wrong
	to climb on logs on something and to get	Partially correct

	there [their] food	

In conclusion, this prototype has gone through many revisions so that it would be more effective for school groups. The chart below supports the trend shown previously in the Lighthouse School data. The fifth grade classes have a better grasp of the concepts than many of the younger students. Each group had seventy percent or more of students who understood that webbed feet were better adapted for swimming. This data shows that this part of the prototype was very simple to understand.

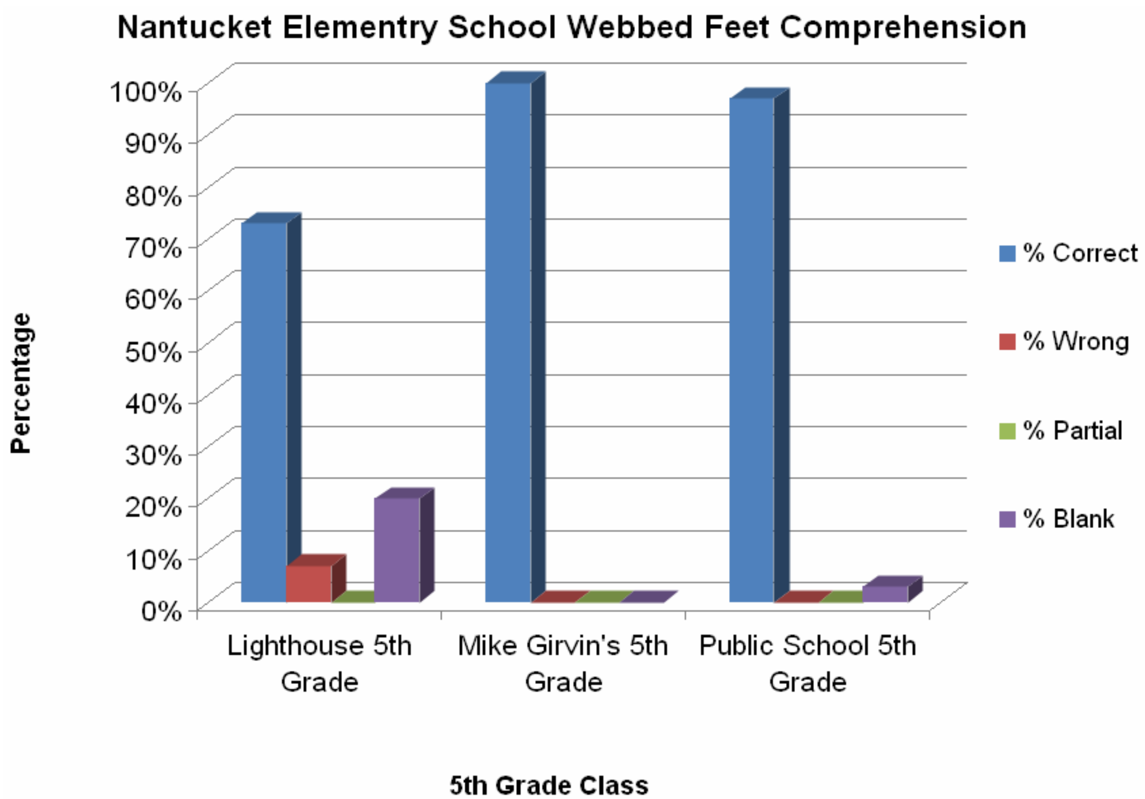

Figure 49: Comparison of Webbed Feet Questions from All 5th Grade Classes

The chart below shows the comprehension level of the three Nantucket Elementary School fifth grade classes. Generally, these classes were able to understand the bird claw prototype. There were very few incorrect and blank responses among the three classes. This suggests that this age group readily understood the concepts presented to them via this prototype. The fact that there are still a few incorrect and blank answers suggests that the topics being taught in the prototype are not necessarily common knowledge so overall, the students learned from this experiment.

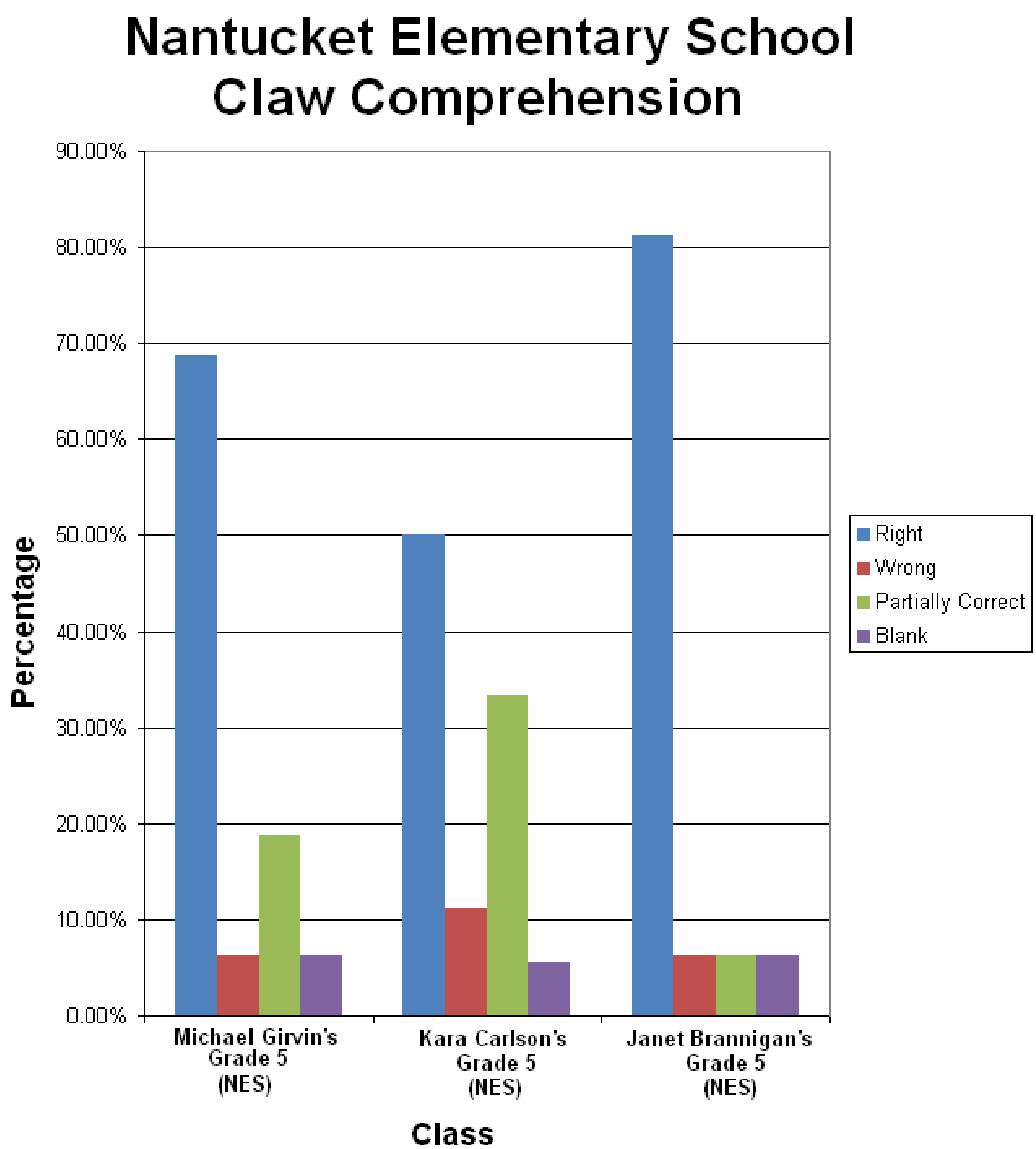

Figure 50: Comparison of Bird Claw Questions from All 5th Grade Classes

All things considered, the bird foot adaptation prototype served its goal by teaching the students. It was revised a number of times to increase its effectiveness in educating these children about bird foot adaptations and the way their design allows them to survive in their respective habitats.

5.2 Objective 2: Increasing School Visitation to the Hinchman House

5.2.1 Determine Curriculum of Target Audience

Over a three week period we were able to interview five teachers from Nantucket Elementary School and attend a teacher's meeting at the Lighthouse School to obtain feedback information about the field trips. The following table shows the natural science topics that were taught by the interviewed teachers. The table also indicates the frequency in which the topics were mentioned, as well as, if the topic is presented in the current museum exhibits. Only half of these topics are present in the current exhibits, excluding the prototypes. Of these topics only three are related to the current interactive exhibits

Table 24: Topics Taught in K-5 Classes

Topics Taught in K-5 classes		
Subject	**Percent of Responses**	**In the Museum**
Geology	100%	Yes
Adaptations	60%	Yes
Plants	60%	Yes
Weather	60%	No
Alternative Energy	40%	No
Animal Life Cycles	20%	No
Classification	20%	Yes
Climate Change	20%	No
Earths History	20%	No
Food Chains	20%	No
Habitats	20%	No
Oceanography	20%	Yes

which focus on identification. Some of these topics such as earth history are presented for classroom use in “Discovery Boxes” located in the basement of the Science Library. The boxes are described by one teacher as “a little kit [that] you could sign it out and it had a whole bunch of materials for classroom teachers to use. And it may have outlined a project,” By incorporating more of these topics in the museum, teachers from all of Nantucket’s schools would be more willing to visit the Natural Science

Museum for a field trip. “If [the MMA] said, “Hey we have this great lesson that matches this on your fifth grade frameworks and we’ll take care of teaching that lesson, that standard,” we could definitely run down there.”

5.2.2 Determine why classes are not visiting the Hinchman House

During our interviews we spoke with teachers who had various experiences with the MMA. Some teachers had participated in field trips many years ago; others had taken their class on excursions with MMA staff, two were former board members and still others had not heard of the MMA Natural Science Museum.

Throughout our interviews many reasons were given as to why teachers were not taking their classes to the MMA’s Natural Science Museum. These reasons are given in the figure on the next page.

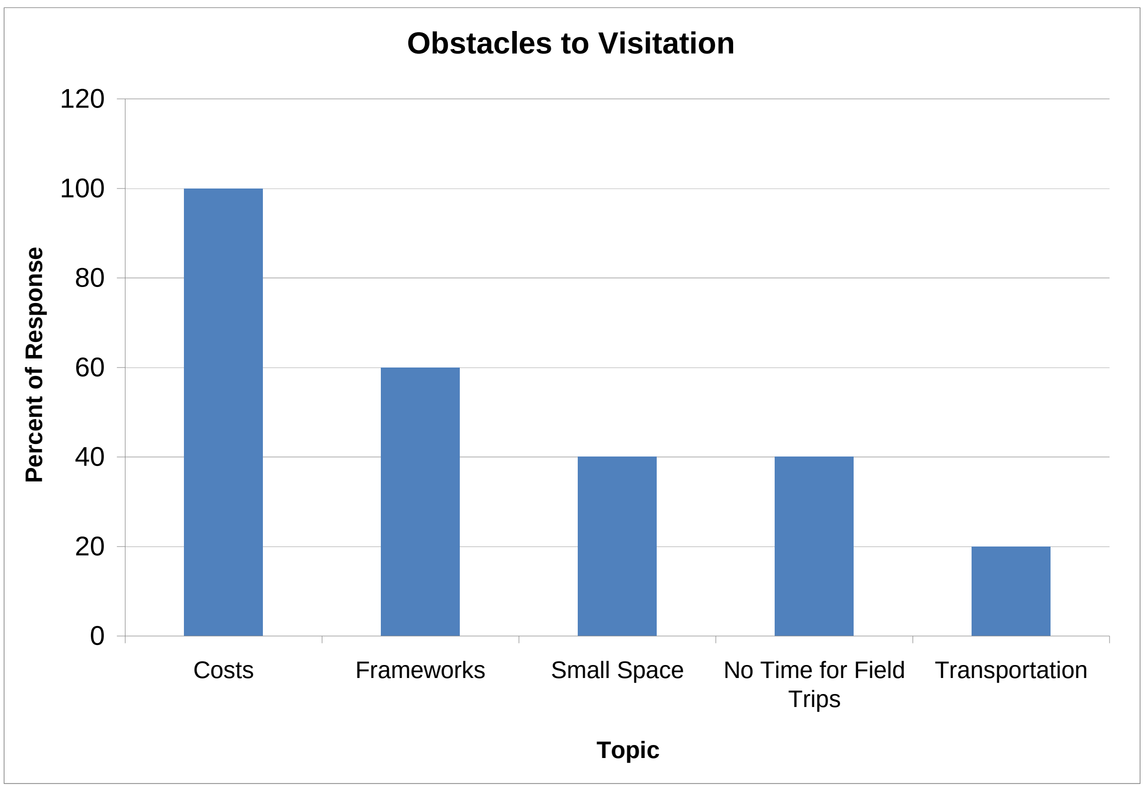

Figure 51: Obstacles to Visitation Brought Up by Local School Teachers

Of the five teachers that we interviewed, all informed us that cost was an obstacle to visiting the Natural Science Museum. As one teacher said, “I know from the public school point of view, with the town budget being locked and the fact that they're going to start cutting jobs at the elementary school… They don't want to be spending other dollars on things like that." Beyond just the cutback that the schools are experiencing in the town's educational budget, the private schools are also worried about the costs of a field trip to the Natural Science Museum. "Yeah, we used Maria Mitchell more until they came up with the cost. The cost has changed now so that's a been a factor at my school, where we have very small budgets and that's unfortunate". While the prices mentioned by one interviewee are slightly off, they were relatively close to the prices that will take affect on November 12, 2009. These rates which apply for school groups of up to twenty people are given in the table below.

Table 25: MMA Program Pricing

Type of Program	Nantucket	Off Island
1-hour program	$75	$100
2-hour program	$100	$150
3-hour program	$175	$250
4-hour program	$250	$325
Astronomy Workshop	$100 for first five per hour; $20 per extra person	
Whale Watch	$4650($650 MMA)	
Seal Cruise	$2700($500 MMA)	
Private Walks	$100 for first five per hour; $20 per extra person	
Tours	$6 per adult/$4 per child	

"It depends…for on-island trips, it generally doesn't cost anything except for the gas in cars, which parents pay for. For off island trips, we usually fundraise and parents pay the difference in cost. The ferries give us a special deal for field trips."

Table 26: Comparing Program Pricing

	Museum Admission	Group of 10-20 People	Cost per Person	Estimated Length of Program
EcoTarium	$6.00	$80.00	$4.00	45 Minutes
MMA	$5.00	$75.00	--	1 Hour

Above is a chart comparing the fees applied to school groups for the MMA and Worcester's EcoTarium. The EcoTarium has a minimum group size of 10 people, including teachers, parents, and chaperons. They also require that a 1 adult to every 10 children ratio be maintained. The Maria Mitchell Association considers a group any size up to 20 persons. The EcoTarium breaks its fees down to four dollars per person with a minimum charge of $80.00. The MMA however, does not have a set charge per person but instead charges a flat fee of $75.00 per group. Based on the comparison chart above it is clear that for the same amount of people, it is cheaper per person to take a field trip to the MMA, and the group would get a longer stay than at the EcoTarium. However, it is important to keep in mind that, due to the limited population on the island of Nantucket, the typical class size is considerably smaller than some schools on the main land. This makes it more difficult for a field trip to keep the relative cost per student down on Nantucket compared to the schools on the main land. When combining this with the continuing budget cuts, it is understandable that many teachers would bring price of field trips up as a major obstacle toward visiting the Hinchman House.

The second obstacle that teachers face, when planning field trips to the MMA, is meeting the state framework requirements. Many teachers expressed interest in bringing their classes to the natural science museum, especially if there was "something that matched a frameworks standard". Another teacher stated that if the MMA approached her and said "Hey we have this great lesson that matches this on your fifth grade frameworks and we'll take care of teaching that lesson, that standard," [she] could definitely run down there". As a result of having to meet the requirements put forth by the Massachusetts Curriculum Frameworks classes are forced to stay inside and teach the frameworks for fear of loosing state funding. This decreases the amount of time that teachers can take their classes out on field trips. In fact two teachers stated that one reason they have not brought their classes to the natural science museum is because they do not have enough time to go on field trips. As one teacher explained, "We don't have time to take a trip just for the sake of taking a trip". When asked if they would like take their classes on a trip the Natural Science Museum one teacher respond "Yes, absolutely. As long as we had support of the school system and the Maria Mitchell then it'd be fine. It'd be great".

The least mentioned topic was transportation which only one of the teachers suggested as an obstacle to visiting the museum. "And transportation would be another obstacle and that it right now". Based on our observations it appears that transportation is not an issue because of a large backing of parental support. In summarizing the field trip planning process one teacher informed us that once a “teacher decide[s] if the field trip would support the curriculum taught and it is supported by the administration. Then we just need to find parent drivers”. This data supports our observations of the classes when they visited to test the prototypes. The Lighthouse School was able to gain access to a bus that brought all of the classes to the Natural Science Museum and the class from the New School was able to find parent drivers to transport the children. Two of the Nantucket Elementary classes walked to the museum while the third was driven by parent volunteers. Since the teacher that brought up the transportation issue taught a lower grade level, the issue may be more prominent than our interviews suggest since many of the teachers who responded to our emails taught grades higher up in the target audience.

6. Conclusions and Recommendations

Over our seven weeks on Nantucket, we made several conclusions based on our observations during the open house and prototype testing. Our interviews allowed us to learn about the schools' curricula and obstacles that they face when trying to get the children out of the classroom. Using knowledge acquired from the background literature as well as our own personal experiences in museums, we determined several recommendations that may help alleviate or solve some of the various trends stated above. Many of our recommendations pertain to both objectives of our main goal: to update the exhibits of the MMA and to bring in more school groups to the Hinchman House.

6.1 Conclusions for Objective 1: Updating Exhibits

Through the analysis of our interviews with the MMA staff, visitor feedback surveys and observations, we noticed several trends in the current exhibits. These trends included inconsistencies and the inability to apprehend the exhibit labels, congestion with larger groups of people, and popularity with the interactive exhibits.

6.1.1 Labeling

On our first walk-through of the museum, we immediately noticed the inconsistencies in or lack of labels in many of the exhibits. We found that many of the exhibits that had text tended to have one of two problems. The first was the identification label, describing basic information such as the scientific or common name of the specimen on display, the name of the collector and the year in which the item was collected. These labels offer nothing to help the average visitor who has no prior knowledge of the exhibits' contents. Furthermore, there are no facts accompanying the majority of the remaining exhibits to stimulate visitors' curiosity. The other way text was commonly displayed was through large paragraphs of information using small single spaced text. These large paragraphs used too much text to explain the exhibits' contents before visitors lose interest.

Another common trend we noticed with the text relates to its accessibility to visitors. In many instances the text was either too high on a wall where children could not see, or was too small to read from a reasonable distance. As the exhibits stand now, the average visitor would spend maybe ten minutes walking through the entire museum, possibly more if they were interested and knowledgeable in a specific area. Instead of updating the labels to be more informative, a tour was designed to guide visitors through the museum and elaborate on the exhibits. This was a good short term fix; however, the tour takes away from what our background literature describes as the most predominant type of learning in a museum: informal or free-choice learning.

It is our opinion that the museum has become too reliant on the tour to make the exhibits understandable. This view was established during staff interviews and confirmed during the open house, when people came in asking for the tour. While the tour helps visitors interpret the exhibits, it has its disadvantages. The tour is not only taxing on the staff, but also counterproductive to the ideal learning style in museums. We do not think the tour should be abolished, however, for many visitors do appreciate the human interaction that comes with the tour as well as the freedom to ask for clarification.

We would like to note that one highlight of the tour is its ability to showcase all of the exhibits including those in the main room. As pointed out by several visitors from the local schools, the exhibits in the main room of the museum are often overlooked since they are overshadowed by the gift shop. In fact many of the exhibits are even overlooked by the tour itself. We believe that one of the main problems with these exhibits is the lack of adequate labeling as well as their placement. While it has been proven that the placement of an exhibit is vital to its effectiveness, it is clear that placement of the exhibits in this museum is a challenge due to the limited space available. Exhibits placed in the corners or along the walls of the main room are generally ignored because they are considered to be out of the way.

6.1.2 Congestion

One side effect of the small museum space is congestion. It was noted during many of our school visitations that congestion is also a big problem with any groups larger than about ten people. This is especially an issue during tours, since interpreters are trying to showcase exhibits and maintain the attention of the visitors who may not be able to see what is being shown. This becomes particularly challenging in the most popular room in the museum: the live animal room. As was suggested by our interviews with the staff, we received overwhelming data that supported our belief that the live animal room is by far the most popular room with the most interesting exhibits. We were able to even out some of the congestion with the introduction of multiple interactive prototype exhibits in the bird room. This change prevented visitors from rushing through the other rooms of the museum to reach the live animal room. This room is popular because it is dynamic and interactive. By adding more interactive exhibits in other rooms, people will likely spend more time in those rooms thus preventing congestion in the live animal room.

6.1.3 Interactive Exhibit Prototypes

During our testing of these prototypes it was confirmed that interactive exhibits were far more popular and appealing to children than many of the static exhibits that currently exist in the Hinchman House. Another trend also noted while testing includes a more refined insight about how the children in our target age group interact with exhibits.

It was noted on several visitations that the children in third grade and below tended to ignore the labels provided for the prototypes and would rather start manipulating them and figure them out. This was explained by the teachers that accompanied the classes, who pointed out that since the children were just learning how to read, it was harder work for them. Therefore, those who were still learning to read would avoid reading unless prompted by someone else. Contrariwise, the students that were in higher grade levels and more familiar with reading had little trouble with the text. To further engage these older kids, thought provoking questions were incorporated into our prototypes. We observed that these questions got the students to think more about the topics presented to them.

6.2. Recommendations for Objective 1: Updating Exhibits

All of the above conclusions prompted further thought regarding the improvement of the museum as a whole as well as updating the exhibits. The following sections provide details about the recommendations this project group has developed.

6.2.1 Labels

Regarding the outdated and uninformative labels, we suggest that a thorough renovation of labels be done. Rather than simply identifying the specimen or exhibit, labels should also include facts that are interesting, relating to either the specimen's life or habitat. Exhibit labels should use large fonts and short, simple language to accommodate the younger children who are just learning how to read and have a limited vocabulary. We suggest that the MMA tries to relate the exhibits to the personal lives of the visitors, either by connecting it to a larger concept or posing thought provoking questions to further engage them. This project group also suggests that new exhibit text is created so that the displays may promote free-choice learning. By making the text more understandable without further explanation from a museum staff member, the exhibits will become self-sufficient and not depend as heavily on the tour.

By reducing dependency on the tour, visitors could be given the option of going through the museum at their own pace while focusing on the exhibits that personally interest them. We are not suggesting that the tour be removed completely, but that the tour is made less prominent. We merely suggest updating the labels, such that they not only identify the accompanying specimens or exhibits but also inform the visitor of various interesting facts regarding them. For those who do enjoy taking the tour through the museum, tours can be scheduled at regular short intervals, so people coming in can browse the gift shop or the exhibits in the main room while waiting for the next tour to start. This will also help prevent the current exhibits in the main room of the museum from being overlooked since there is little or no room to put them elsewhere.

6.2.2 Layout

Regarding the layout of the museum, we suggest reorganizing the exhibits such that each room represents one of four habitats and the main room focuses on the formation of Nantucket. We envision the current general ecology room as a room themed toward Nantucket fauna in the air, the bird room being themed toward land based creatures on Nantucket, the marine room taking a closer look at fresh water systems on Nantucket, and the current live animal room focusing on salt water habitats on Nantucket. While the salt water room would discuss topics presented at the aquarium, it would allow school groups the opportunity to learn this information since the aquarium is closed during the school year. A representative map is given in the figure below.

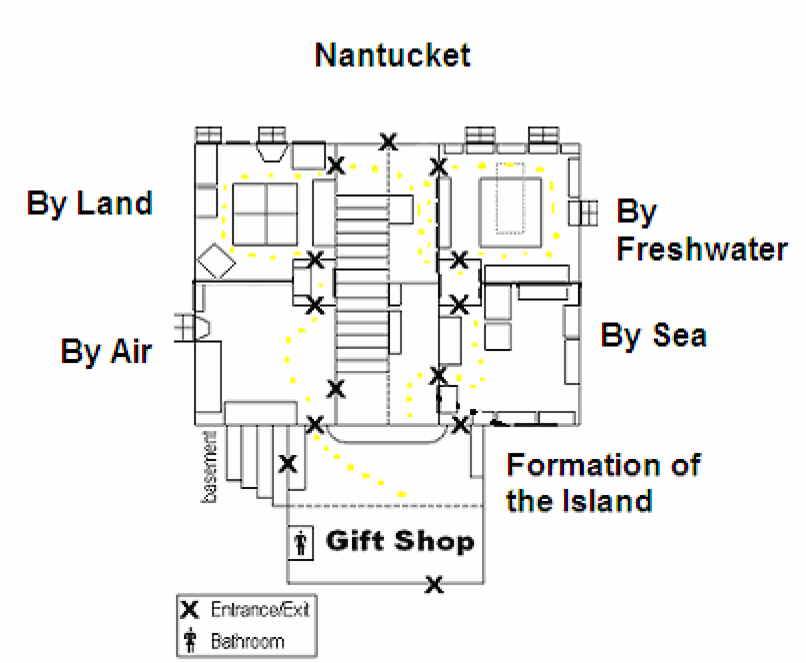

Figure 52: Suggested Layout of the Updated MMA Museum

We suggest displaying these habitats through the use of murals, models and collections of flora and fauna found in each. This project group also recommends incorporating sound into the exhibits, such as bird calls in the Nantucket by air room or whale calls in the Nantucket by sea room. These sound clips could be softly playing as background noise or they could be accessed through an earphone device so that the sound does is not carried into the other rooms. These sounds will help create the atmosphere of the habitat being presented and incorporate another sense, hearing, into the way that the child learns. The lessons learned in these habitat rooms could also be reinforced by field trip excursion to the actual habitat which would further support the rest of the MMA’s programs.

We suggest that all exhibit cases and shelves be lower to the ground to accommodate the small stature of the target audience. Not only do children have difficulty seeing exhibits that are high up, but even many adults are unable to see parts of the displays. Also it is advised that exhibits be made accessible from multiple angles in order to allow multiple people to view the same exhibit without causing congestion in the flow of the museum. We suggest utilizing the ceiling space to help bring the feel of the habitat to the museum by having model birds soaring overhead in the Nantucket by air room, or giant insect models in the Nantucket by land room. These displays should be purely decorative and not detailed exhibits that are trying to teach a concept, since visitors will be inclined to read labels on the ceiling. In addition, we recommend that the MMA look into incorporating models that bring small concepts and objects to human scale. We feel that this will help children see and understand the lessons being taught.

6.2.3 Exhibits

To keep things fresh and new in the museum as a whole, we suggest periodically rotating out various collections as well as the lessons they cover. For example, at the beginning of the summer, the freshwater systems room can teach about various adaptations of certain fish while the Nantucket by land room can teach about the food chain that exists in that habitat. Then in the middle of the summer, the exhibits can be switched such that another room focuses on adaptations and yet another teaches about the relative food chain. We feel this incorporation of new exhibit topics every couple of months will be sure to bring back visitors who might not return otherwise.

After interviewing the opinions of several of the MMA staff, we feel that it's best to minimize the installation of technology as it is distracting and can take away from the overall experience as well as the atmosphere. This quaint museum house provides very small exhibit spaces that we believe would be overpowered by overly technological exhibits and over stimulate the children. While this project group understands the opinions of some to maintain the feel of the current old style museum, we believe that to successfully reach the largest amount of the target audience, hands-on interactive exhibits must be included in the museum since the current layout is not accessible to this projects target audience.

6.2.4 Congestion

As was clearly evident from the school visitations, interactive exhibits are highly preferred over the alternative. For the permanent incorporation of interactive exhibits, it is our opinion that they should be spread out, both throughout the room and throughout the museum. Spreading out the interactive exhibits will help avoid having another "live animal room" situation, where all the visitors want to go to one specific room in which all the interactive exhibits are located, overlooking everything else on the way. Spreading out the interactive exhibits also helps lessen congestion within the rooms. To further help against congestion, we recommend that some doors be removed while the museum is open. A good example is the door connecting the current Bird Room to the front hallway. This door, as well as the one leading to the Marine Room serve no purpose, but rather get in the way when big groups come through at the same time. This is because the doors stick out slightly beyond the exhibit cases forcing people to walk around them.

Just as we suggested spreading out the interactive exhibits, we also recommend spreading out the live animal exhibits into their respective habitat themed rooms. During all of the visits we held at the museum one common observation was that children loved being able to see live animals. By dispersing the live animals throughout the museum, children may be more excited to visit all of the rooms and can learn about the animals while simultaneously learning about the environment they live in. For example, ground snakes and some spiders can be moved into the Nantucket by land room, while birds and flying insects can be displayed in the Nantucket by air room. This habitat dispersion would also allow for the winter housing of Aquarium animals in the Nantucket by sea room. Amphibians can be placed in the fresh water systems room as well. This will give each room a more equal sense of popularity since each room will have some of both live animals and interactive exhibits.

6.3 Conclusions Objective 2: Increasing Visitation

Our second objective was to find out why more school groups do not visit the Hinchman House for field trips. Through our interviews with local teachers we were able to determine the science curricula of the kindergarten through fifth grade classes. While many of the subjects mentioned, such as geology, plants, and adaptations are discussed in the current museums exhibits, other subjects, such as weather and alternative energy, are not. Overall, it was found that many of the topics covered in classrooms were also covered in some way in the Hinchman House.

These interviews also allowed us to determine what obstacles are preventing the teachers from taking their classes to the MMA. We were also told by several teachers that tying a fieldtrip to the Hinchman House to their lesson plans, which are based off of statewide guidelines, can be difficult. These guidelines and requirement, known as frameworks, outline topics the government believes children should know before the completion of each grade. These state frameworks can be viewed in their entirety in Appendix K. Many teachers also expressed their interest in more interactive exhibits in the museum. This has already been addressed above. One topic that was brought up in every single interview was the cost associated with taking field trips both to a museum and into a habitat. However, we looked into the prices charged to school groups on the island and compared them to a small museum on the mainland. Our comparison showed that they both had relatively the same pricing with the MMA charging slightly less than other museums. The teachers also expressed a lack of time for taking a field trip because of their need to meet the state standards; however, they expressed a strong interest in visiting the museum should it be covered in the frameworks.

6.3.1 Collaboration

During interviews with local teachers, we discovered that many schools do not visit Hinchman House on field trips. Many of them do, however, organize field trips with other naturalist organizations. Some teachers mentioned that they worked closely with the UMass Field Station and the Nantucket Land Council. The Maria Mitchell Association offers similar field study opportunities such as nature walks with on-site collection.

6.4 Recommendations for Objective 2: Increasing Visitation

To help overcome the obstacles listed above we have several recommendations for the MMA. Regarding the scientific topics covered in the museum, we found that many of the topics mentioned by teachers were covered but not extensively as could be hoped. Therefore we suggest the adding to and elaborating on the topics presented in these exhibits. We also suggest that the museum expand its exhibits by covering some of the topics that are not currently covered in the museum. Some of these topics could easily be incorporated into the suggested layout mentioned in section 6.2.2. For example the topics of weather could be briefly discussed in every room. The Nantucket by Sea Room might discuss how ocean evaporation affects the weather on the island while the air room might discuss how air pressure, the jet steam and other factors affect weather.

6.4.1 Specific Tours

We also suggest that someone on the MMA staff create a detailed breakdown of the specific frameworks that are covered by each exhibit. This data can be then used to create specialized tours and activities tailored to a specific topic or idea. In fact, many teachers expressed interest in bringing their children to the museum for a tour on a specific subject and related activity workshop after. This project group believes that themed tour-activity related school programs could greatly increase school visitation. One example is a themed tour on adaptation which could be followed by an activity where children can create their own animals and determine what type of habitat they would live in because of their features.

6.4.2 Discovery Boxes

While the natural science museum does not offer information about weather, life cycles or Earth's history, the Education Department of the MMA does offer discovery boxes covering these concepts. These boxes are kits complete with a lesson plan, materials for hands-on activities, and instructions. They cover many topics that the museum itself does not and each kit is based on the Massachusetts Science and Technology/Engineering Curriculum Framework. (See Appendix L for a detailed list of the discovery boxes). These boxes are available to local schools upon request and may be taken to classrooms and returned after each use. This is an excellent outreach program that is likely to increase teachers' awareness of the Maria Mitchell Association and what it has to offer. We also believe that it will encourage more teachers to see the natural science museum as a potential field trip in the future. We recommend that the MMA utilize these discovery boxes more often when collaborating with local school teachers.

6.4.3 Communication

In order to increase the number of field trips in general, we suggest that the communication between the MMA and local schools be reinforced throughout the year. We also recommend meeting with the teachers in person a few times a year. This recommendation is based on our own experience of emailing the local teachers, which suggests that many do not check their mail. As a result many of the teachers did not know about the MMA's discovery boxes. It is our belief that if the teachers we interviewed knew about the existence of the discovery boxes, they would be very interested in using them for their classes. We found that the teachers tended to be more open to working with the MMA after meeting staff in person rather than simply being sent emails and fliers of what the MMA has to offer.

6.4.4 Collaboration

We highly suggest that the MMA collaborates with other local organizations, especially those concerned with naturalism such as the UMass Field Station. This would allow the Maria Mitchell Association to become better known throughout the local schools, in addition to building new partnerships with other similar organizations. This will provide the MMA with a larger audience from local schools as well as more opportunities to allow students to explore Nantucket's unique environments.

6.4.5 Cost

Finally, to help schools with any associated costs for going on field trips to the museum or to a specific habitat, we recommend that the MMA look into various grants, to allow class visits to the museum at reduced or no charge. We also recommend applying for grants to update the museum as we recommend in section 6.2. By updating the exhibits to incorporate more hands-on activities, creating themed tour-activity programs and helping the schools meet the cost of the field trips; many of teachers we spoke with would be very interested in bringing their classes to the museum.

It is our hope that after taking heed to our recommendations, the museum will be more balanced in popularity and bring in more newcomers and returning visitors.

7. Appendices

Appendix A – The Maria Mitchell Association

"We especially need imagination in science.

It is not all mathematics, nor all logic, but is

somewhat beauty and poetry."

These powerful words were spoken by one of the most groundbreaking women of the 19th century, Maria Mitchell. As the first female astronomer to be recognized in the United States, she pioneered the way toward women's right to aspire to greatness. With her love for the natural beauty of Nantucket and her father's strong teaching influence, Maria dedicated herself to teaching other women as a professor at Vassar College.

In the present era, the Maria Mitchell Association carries her vision on through the exhibits, programs, research, and other activities of the Natural Science Museum. The museum strives to educate the public through diverse programs that encourage interactive, hands-on learning. The Association comprises several buildings: an aquarium, natural science museum, two observatories, a scientific library, the Mitchell House and an administration cottage. The locations of these buildings, as shown in Figure 53 on the next page, are relatively close together; however, a few are spread out on the island.

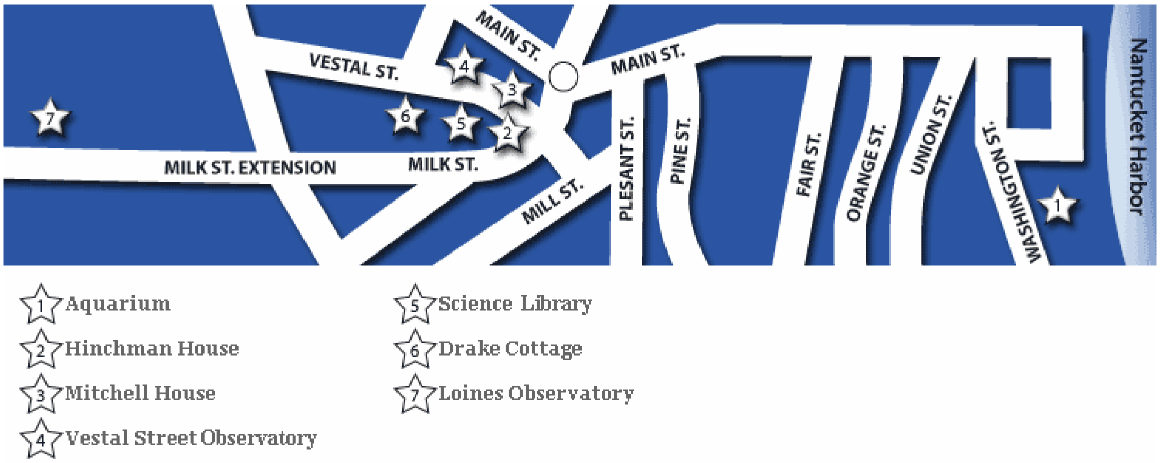

Figure 53: The Maria Mitchell Association Map

The aquarium, which is filled with animals caught during the spring season, and the Mitchell House, which allows visitors to see where Maria grew up and lived, are closed during the fall and winter seasons. The Loines Observatory is primarily used for research purposes; however, lectures and tours are given at night during the first quarter of the moon. Currently the Science Library is closed to the public, while the Vestal Street Observatory and the Hinchman House, where the Natural Science Museum is located, are both open year round for various activities and programs. The operating seasons and distance between buildings makes visit all of the different locations of the MMA difficult, especially during the off/ winter season. In conjunction with these various learning institutions, the association offers programs that use Nantucket's natural environments as a tool for hands-on learning. These programs include fungus walks in the protected forests on the island as well as bird and geological walks around the island. By reaching out to local and statewide schools as well as other institutions the MMA discovers new ways to reach out to the community, and consequently continues Maria's legacy of teaching.

The astronomy research program, directed by Dr. Vladimir Strelnitski, has employed visiting staff from the University of Florida, Gettysburg College and the Sternberg Astronomical Institute of the Moscow State University. This research program is also part of the Research Experiences for Undergraduates program (REU) which appoints six undergraduate interns every year from colleges and universities across the country. Some examples of research in progress include the study of comets, planetary development, astrophysical masers and lasers, and peculiar variable stars. The MMA uses a 24 inch Ritchey-Chretien optical telescope located at the Loines Observatory and numerous telescopes located around the country to study outer space. The other telescopes are located at the Steward Observatory in Arizona, MIT Haystack Observatory in Massachusetts, the Very Large Array (VLA), a twenty-seven dish system, in New Mexico and the Very-Long-Baseline-Array (VLBA), a ten dish system distributed throughout the western hemisphere.

The Natural Science Department of the MMA focuses on educating the community about the island's natural ecosystem. Areas of wildlife study in this department include: ornithology, botany, marine biology and entomology. One ongoing project is the reintroduction of the American Burying Beetle, an endangered species, to the island of Nantucket. For this project, the MMA is collaborating with the Roger Williams Park Zoo and the U.S. Fish and Wildlife Service. There is also a study in progress to determine if a new species of black widow spider has been discovered on neighboring Tuckernuck Island. This new species is the possible discovery of the MMA's Assistant Director of the Natural Science Department, Cheryl Beaton. The department also collaborates with local Nantucket schools alongside the Nantucket Biodiversity Initiative. "This collaborative effort is being undertaken to inventory and monitor the many species of plants and animals found on Nantucket and to educate the public about the importance of protecting the rare elements that contribute to Nantucket's rich local biodiversity, (Nantucket Biodiversity Initiative, 2008).

In the spirit of education, the MMA hosts a variety of educational programs for all ages and backgrounds. They offer everything from summer classes and school field trips, to adult workshops and fishing outings. The Field Geology Workshop allows participants to travel to the terminal moraine of Nantucket to observe glacial erratics and fossils found in eroding cliffs. The MMA, in conjunction with Shearwater Excursions, takes students on Seal Trips and Whale Watches. These voyages allow passengers to witness the creatures in their natural environment while listening to discussions about their traits and biology. The Loines Observatory is used to give lectures and observation tours of the observation of celestial bodies and constellations in the Astronomy Workshops. These workshops also feature a presentation of the research telescope and its machinery. The museum also features interactive classes such as “Growing Up Wild”. This program for children four to six years of age covers topics including the life cycles of invertebrates.

Along with the outdoor excursions and workshops, the MMA Natural Science Department also contains the indoor Natural Science Museum. This museum, located on the first floor of the Hinchman House, consists of four small rooms, a hallway and a larger room that is partly occupied by a gift shop and changing exhibits displays. The larger room is used for group activities and programs as well. Currently these exhibits highlight the astronomy department and Maria Mitchell’s discoveries in celebration of the 190th anniversary of her birth. The other four rooms contain exhibits on native birds, identifying different nests, the geographical formation and history of Nantucket, marine mammals, and types of seashells. One of the rooms is devoted to housing live animals. These animals include but are not limited to various types of spiders, snakes, turtles, and frogs. The animals housed in this room are used for educational programs as well as exhibits for the museum. Many are caught during the spring and released in the fall to survive on their own until next year.

Currently many of the exhibits are static, primarily containing taxidermy, simple matching puzzles, illustrative wall panels, posters and text descriptions. It is also the MMA’s belief that “the [Natural Science] Museum’s exhibits are the weakest link in [their] education and research program... and provide little background to learn about Nantucket or the human impact on the natural world.” (Schulte, 2007, 4) The general ecology exhibits can be found in wood and glass display cases, and geographic maps with illegible text high on the walls. During the summer potted plants that are native to the island can be found in front of one of the windows; however, they are removed during the winter season. While most of the exhibits utilize the same static and staid exhibit methods that do not encourage visitor interactivity and engagement, many feature “an array of objects donated over the past century with no real theme or explanation as to their purpose or importance to the visitor or their role in the natural world" (Schulte, 2007, 4) . According to Schulte, the MMA also possesses "several biological collections that represent specimens from the island's habitats over the past century or more" (4). These primary collections contain thousands of specimens and are stored in cabinets in the basement of the Hinchman house along with several smaller secondary collections.

To keep up with modern times the MMA's natural science departments is working in conjunction with Worcester Polytechnic Institute students to develop new, interactive, and informative exhibits to best reach a new generation of visitors. It is the MMA's hope that new exhibits will "serve as portals to engage the visitor in discovering the unique habitats, rich biodiversity, and broader scientific issues that exist on Nantucket" (Schulte, 2007, 6). As indicated by Schulte, possible exhibit topics may include endangered habitat, the sand-plain grasslands of Nantucket, the diverse animal species on the island, and Nantucket's fresh water systems. The MMA would like the new exhibits to support and reinforce the outdoor programs. Many staff members have indicated that the Natural Science Museum needs a complete overhaul of its exhibits and look forward to a redesigned museum that helps educate the community about its surroundings.

Maria Mitchell's legacy of giving back to the community can be seen in strong volunteer support. The Natural History Museum serves the entire island and all its visitors. The MMA's workforce consists of mostly volunteers with a handful of full time employees, including Darcie Vallent as Director of Education, Dr. Vladimir Strelnitski as Director of Astronomy, as well as our main contacts: the Executive Director, Dr. Janet Schulte, and the Director of Natural Science, Dr. Bob Kennedy.

The MMA is a private, non-profit organization that partially relies on private donations. For the fiscal year of 2007, the amount of money received from revenue and support totaled $1,212,143, which was only 14.1% of their total net assets for the year ($8,593,996). Business Partnership is based on an individual or organization's level of financial support. This year's partners include: five contributors at the “Cardinal” ($250) level, three contributors at the “Oyster Catcher” ($1,000) level, and three contributors at the “Osprey” ($2,500) level.

A couple of sources of revenue for the museum come from admission fees and gift shop sales, $34,372 and $31,767 respectively. Admission fees range from $5-10, while membership and packaged deals are also available. Last year, nearly 10,000 people visited the MMA, with “nearly 1,300 people visit[ing] the Natural Science Museum in Hinchman House” and 8,500 visiting the MMA’s Aquarium (Schulte, 2007b, 10). There are varying levels of member support with increasing benefits; however, all members gain free access to Open Nights and Nature Walks as well as unlimited free admission to museums. Membership fees range from $30 to $5000 and made up 9% of the total revenue in 2007. Another source of the MMA’s revenue comes from their various program admission fees which totaled $122,531 in 2007. All of this financial support stands as a testament to the spirit of Maria Mitchell and her goal of teaching Nantucket and the world, without borders.

Appendix B: Interview Questions

Appendix B-1: Betsy Loring Interview Questions

How do you generally brainstorm ideas for exhibits?
How does the exhibit design process work?
When/how do you determine when you need a new exhibit or to update an existing one?
What do you look for when creating new exhibits?
What are the goals you hope to achieve through your exhibits?
What methods of exhibit design do you typically utilize to achieve this (these) goal(s)?
Do you ever collaborate with other people/groups when brainstorming/designing an exhibit? If so, who?
Do you prototype your exhibits? If so, how?
How long does it take to prototype an exhibit?
How many versions/refinements do you make on a prototype for one exhibit?
What materials are best suited for prototype fabrication?

Appendix B-2: Christopher Whitehead Interview Questions

How long have you been a part of youth programs, here or elsewhere?
What is the goal/mission of youth programming at the Worcester Art Museum?
Why do you feel it is important for museums to reach out to children/adolescents?
What types of the programs does the Worcester Art Museum primarily have for youths?
What are the types of programming that you are in charge of specifically?
How do you decide what topic/ activity to create a program for?
Do you ask the public what they would like a program on, and if so how do you gather information on what type of outreach program the public would appreciate?
What steps must be taken for a museum to create youth programs?
What is the best way to start a new youth program or set of youth programs, primarily for K-12 students?
How long does the typical development process take for a new youth program?

Appendix B-3: Martha Cyr Interview Questions

How long have you been involved with outreach at WPI?
Why do you feel outreach is so important in this day and age?
Why do you feel it is important to encourage STEM to children?
Does the incorporation of STEM into outreach programs help with the funding of those programs?
How much focus on STEM topics does an outreach program have to use in order to get funding?
In what ways does outreach enrich the curricula of local schools?
What do you believe defines a good outreach program?
What are key aspects in a good outreach program, especially with regard to 5 to 12-year-olds?
What kinds of programs have you been a part of for this age range?
What kinds of outreach programs are best for K-6 graders?
What steps must be taken for an institution to create an outreach program?
Who is involved in the creation of an outreach program? Is a special committee formed? (Teachers and museum staff)
How long does the typical development process take for a new outreach program?

Appendix B-4: Sue Reidy Interview Questions

How would you describe your position here at the EcoTarium?
How long have you been involved with outreach at the EcoTarium?
What types of the programs does the EcoTarium primarily have for youths?
Why do you feel outreach is so important in this day and age?
Why do you feel it is important to encourage STEM to children?
In what ways does outreach enrich the curricula of local schools?
What do you believe defines a good outreach program?
What are key aspects in a good outreach program, especially with regard to 5 to 12-year-olds?
What kinds of programs have you been a part of for this age range?
What steps must be taken for an institution to create an outreach program?
How long does the typical development process take for a new outreach program?
How do you decide what topic/ activity to create a program for?
Do you ask the public what they would like a program on, and if so how do you gather information on what type of outreach program the public would appreciate?
What steps must be taken for a small museum to create youth programs?
How do you advertise your outreach programs?
How important is volunteer support for small museums?
How do you get volunteers?
Do you use volunteers for your outreach programs?
If so how do you get volunteer support?

Appendix B-5: Interview Questions for Andrew McKenna-Foster

What do you believe the goal of the current museum is?
What are your opinions of the current exhibits?
What exhibits do you believe work the best and why?
What exhibits do you believe are least effective and why?
What are your opinions of the tour?
Do you believe the tour should be as prevalent in the updated museum, or should it be scraped all together?
What topics do you are not represented enough in the museum?
What is your vision of the updated museum?
What type of exhibits would you like to see in the updated museum?

Appendix B-6: Generic Teacher Interview Questions

What grade do you teach? K 1 2 3 4 5 6 _____

Have you been to the Maria Mitchell Association Natural Science Museum yourself? Y N

Have you ever brought your class on a field trip to the Natural Science Museum? Y N

If yes, when and how often do these field trips take place?

If No, would you be interested in taking your class on a field trip to the Natural Science Museum? Y N

Why would you be interested in taking your class to the Natural Science Museum?

Do you feel that field trips to the museum would enhance your curriculum? How?

Do you think the Natural Science Museum incorporates STEM (Science Technology Engineering Math) topics in its exhibits? Y N

Do you think the Natural Science Museum needs to incorporate more STEM topics into its exhibits? Y N

What topics do you believe are covered well by the Natural Science Museum?

What topics do you believe are missing from or are not covered well by the Natural Science Museum?

What science topics are in your curriculum?

What do you believe the Natural Science Museum can do to improve its current exhibits?

What are the obstacles that keep you from going on field trips in general?

What are the obstacles that keep you from going on field trips to the MMA?

What would the Maria Mitchell Association need to do to attract your class and or school to take a field trip to the Natural Science Museum?

Do you see the MMA as being a part of the community? Y N

If yes, how so? If not, why not?

What do you believe the MMA can do to improve its community awareness?

Appendix B-7: New School Teacher Feedback Form

What science topics do you teach in your class?

____

____

____

Do you feel that field trips to the Natural Science Museum would enhance your curriculum? How?

____

____

____

What topics do you believe are covered well by the Natural Science Museum?

____

____

____

What topics do you believe are missing from or are not covered well by the Natural Science Museum?

____

____

____

Do you feel that the bird feet adaptation exhibit was beneficial to your students? How?

____

____

____

Do you feel that the bird beak adaptation exhibit was beneficial to your students? How?

____

____

____

Do you feel that the erosion book was beneficial to your students? How?

What do you believe the Natural Science Museum can do to improve its current exhibits?

What are the obstacles that keep you from going on field trips to the MMA?

What is the process for proposing a field trip entail?

How are field trips arranged at your school? Does the school cover the cost completely or do the parents pay a certain amount for a given trip? Please explain.

What would the Maria Mitchell Association need to do to attract your class and/or school to the Natural Science Museum?

Appendix C: Interview Notes and Transcriptions

Appendix C-1: Betsy Loring Interview Notes

How do you generally brainstorm ideas for exhibits?

- Know topic
- Talk to person who does programming and talks to visitors
- Children's books – break down subject
- Need more ideas than exhibit space
- Observations
- How to turn data into exhibits
- Build prototypes
- Talk to visitors about their perceived goals

How does the exhibit design process work?

- Location of text is important
- Make prototype durable enough to use but fluid enough to make quick/easy changes
- Know topic→ brainstorming→Build and test prototype→sent to exhibit designer→review playground regulations

When/how do you determine when you need a new exhibit or to update an existing one?

- Out of date
- Have $ to spend for updates
- What is not being taught by schools
- How often want visitors to come back

What do you look for when creating new exhibits?

- Helps organize
- Depends on traveling exhibit or permanent
- Have a master plan
- Topic jumping off point
- What we want MMA to be about
- Not worth doing if visitors are unable to have fun

What are the goals you hope to achieve through your exhibits?

- Give visitors a fun time
- Interview staff, visitors and members

What methods of exhibit design do you typically utilize to achieve this (these) goal(s)?

- Prototyping- making sure the exhibit works
- Don't do badly what someone else can do better in another media
-

Do you ever collaborate with other people/groups when brainstorming/designing an exhibit? If so, who?

- Yes; collaborate with other museums or universities
- Mostly large univ. → museums, large museums and smaller museums
- Grants drive exhibits

Do you prototype your exhibits? If so, how?

- Yes; build, test with visitors, rework, repeat
- Build and put on floor
- Exhibit prototype to grocery store/dump
- What is out there that no one is tapping, find a niche
- Observe close at first w/out freaking out the visitor
- Checklist of group stats and comments

How long does it take to prototype an exhibit?

- Need access to visitors over a chunk of time
- Look for family gathering places (i.e. mall, supermarket
- If using recycled cardboard boxes, suggest that we cover up original box text
- Depends on exhibits

How many versions/refinements do you make on a prototype for one exhibit?

- Lots of versions
- Use flexible materials – paper and tape labels
- Generally when wrong change something out
- Tweak like crazy until you get it
- Change right away, easily exchangeable prototypes

What materials are best suited for prototype fabrication?

- Sturdy but cheap
- Foam board
- Plastic
- Tape
- Paper
- Easy to change and update

Other comments

- Need access to visitors over time, shopping mall, grocery store
- Office supplies
- Shipping tape
- Cardboard – cover up old text, people will try to make meaning for everything they see
- Avoid having resets: hidden or meaningful
- Town dump/ community hang out
- Compare themselves to animals
- Listen to your explanations
- Live animals →basic thought hands on!!!
- Enhance vision
- Give log for notes, pics etc.
- Data taking put themselves in exhibit
- Label writing
- 1st thing – watch
- listen to conversations
    - questions
    - frustrations
- starting point be very specific

- Beverly Serrell –labels
- Ex: Heat lamp turtle (moves toward warmer climate)
- Log/journal/pictures
  - Prompt questions
  - Give hints to look further/notice
- Anatomical comparison
- Simple tanks (bloodsuckers)
  - Leeches
  - Mosquitoes
- Prototype to visitors
  - Minds in vacation mode
  - Exhibit must speak for itself
  - Invite visitors to take data/create graphs/human graphing (heights)
- Observation
  - As close as possible without scaring visitors
  - Check list:
    - Demo
    - Did they turn knob?
  - Family meeting/gathering places
    - Intuitive human interface

Appendix C-2: Christopher Whitehead Interview Notes

How long have you been a part of youth programs, here or elsewhere?

- 2 yrs @ WAM
- 7 yrs as high school administrator – helped give valuable experience working w/ students, parents, and administrators
- teaching experience is a job requirement for here and elsewhere

What is the goal/mission of youth programming at the Worcester Art Museum?

- Financial Goal: each yr makes enough $ to pay for next yr
- Educational Goal: advance student education through art
- Attendance Goal: bring more people to the museum
- Youth program contributes to both education and attendance goals

Why do you feel it is important for museums to reach out to children/adolescents?

- Art is beneficial to the community, museums are a cultural promotion, and they introduce children to the arts
- Museums offer alternative viewpoints of the world as well as develop creative problem solving skills
- Keep in contact w/ local art teachers, go to block parties; offer scholarship programs
- Pay attention to MA content standards
- Pay attention to budget cuts: if a certain topic is cut from public school curricula, can accommodate @ museums
- Only hire professional teachers and artists
- Go to conferences to keep up to date methods

What types of the programs does the Worcester Art Museum primarily have for youths?

- Onsite programs
- Special workshops during school vacations
- Family days – invite families to view the museum and do activities
- Member benefits (Birthday parties)
- Special classes custom for special groups (i.e. scouts)
- After school programs
- Teachers come to WAM to learn ways to teach art

What are the types of programming that you are in charge of specifically?

- all onsite youth programs
- computer studio
- teach adult classes
- bringing teachers for conferences/seminars

How do you decide what topic/ activity to create a program for?

- Age group and media
- Topics not presented in school systems
- Use prior success data – change not type of class but class focus

Do you ask the public what they would like a program on, and if so how do you gather information on what type of outreach program the public would appreciate?

- Do not ask public
- Get yr round input from classes
- Recommendations from instructors
- They don't use surveys (too time consuming)
- Run program concept by several parents to get opinion

What steps must be taken for a museum to create youth programs?

- Budgeting is a huge process (hard to support/maintain)
- Seek grants (time consuming)
- Make program cost effective
- **Need** initial funding

What is the best way to start a new youth program or set of youth programs, primarily for K-12 students?

- Refer to other programs
- Incorporate aspects into your program (not exact same program)
- Talk to artists/teachers
- Design around specific parameters, for example: Girl Scout badges, school curricula, etc.

How long does the typical development process take for a new youth program?

- 5 yr transition period (if the program doesn't fail in 5 yrs, should be good to last however long you want to keep it up for)
- way the program is offered may change

Other comments:

- WAM had classes since 1906
- Sat. bus brings kids to class (free transportation)
- Extend a day daycare offered @ WAM
- Tried using survey monkey to find what pubic want
- Talk to investors, people who planned programs
- Advertise: fliers, handouts, posters on streets are most effective, email, website, descriptive brochures
- Another department in charge of outreach @ WAM is Alex _____, who is in charge of developing classes for teachers on how to teach art ideas, which Chris then teaches
- Still good idea to consult MMA volunteers, school teachers, talk to parents, board of recreation for Nantucket

Appendix C-3: Martha Cyr Interview Notes

How long have you been involved with outreach @ WPI?

- 3.5 yrs @ WPI – Engineering, Science, and Math
- 9 yrs @ Tufts – concentrated on bringing Engineering only
- 14 yrs total
- MA & PHD @ WPI

Why do you feel outreach is so important in this day and age?

- Education of next generation
- Teachers need assistance w/o taking over their job

Why do you feel it is important to encourage STEM to children?

- Fundamental set of knowledge that produces better citizens
- A significant portion of educators are not comfortable w/ STEM themselves (not comfy = won't teach)

Does the incorporation of STEM into outreach programs help w/ the funding of those programs?

- Yes – can help because industry sees a need for STEM knowledge (even small businesses)

How much focus on STEM topics does an outreach program have to use in order to get funding?

- *paused, remarked that it was an "interesting question"; does not know*
- all WPI outreach program is run on funding (no tuition $ are spent)
- *made suggestions on good strategies for getting grants* :
    - can you make a convincing case
    - must have ability to pursue
    - all about marketing the program

In what ways does outreach enrich the curricula of local schools?

- Depends on how it's done *gives 3 example methods*
    - [college] students go to schools (kids see role models and believe they too can be STEM students
    - Professional development for teachers – bring teachers to WPI for a teaching seminar, refreshing them on how to teach STEM topics and also increasing comfort level and ability to discuss such topics in class
    - Bring students to WPI (not as tied into school systems)

What do you believe defines a good outreach program?

- "I think a good outreach program will meet all or most of its objectives."
- Should establish reasonable goals so everyone is not frustrated
- Measure success on goals achieved
- Need program where people feel successful and show increased knowledge of topic

What are key aspects in a good outreach program, especially with regard to 5-12 yr olds?

- Teachers like museums that tie into MA's state education standards
- Tie each exhibit to a standard if possible

OR

- Change overall experience, for example: museum passport/scavenger hunt that ties to MA standards so that the teachers simply have to print out a scavenger hunt sheet and bring them to the museum

OR

- Broaden prospective of old, boring exhibits

What kinds of programs have you been a part of for this age range?

- Done professional development for teachers who teach in that level
- “Engineering is Elementary” program – students go through science topics related to engineering
- done unit on plants and pollination (developed by Boston MOS) which utilized a story book and an activities/tasks book

What kinds of outreach programs are best for K-6 graders?

- Hands-on
- Not too abstract
- Needs to answer “why am I learning/doing this?”

What steps must be taken for an institution to create an outreach program?

- Committed faculty
- Need resources (dependant on type of program) – working space; physical materials
- Flyer/marketing scheme (advertise)

Who is involved in the creation of an outreach program? Is a special committee formed?

- No special committee
- people who speak up

How long does the typical development process take for a new outreach program?

- figure out where the MMA want us to concentrate and how committed they are to developing the program
- maybe not change exhibits but experience of visitors
- maybe convincing teachers of value of exhibits w/ regards to MA standards
- need target audience
- school system needs to see value
- good communication between parties
- keep positive as possible

Appendix C-4: Sue Reidy Interview Notes

How would you describe your position here at the EcoTarium?

- Natural Science programs, programs dept.
- After school programs
- Got into – interested since child in Natural world, interested in Bio, visited museums as a child

How long have you been involved with outreach at the EcoTarium?

- 5 yrs. 1 yr as volunteer 4 yrs as worker
- K-12 generally/natural science program

What types of the programs does the EcoTarium primarily have for youths?

- Average K-8, see packet
- Kits? Wind/solar/H-fuel cells
- Everyday science class
- "night journeys"- sleep over @ museum, see "field trip planner"

Why do you feel outreach is so important in this day and age?

- Inspire kids appreciate environment and see the natural world
- Kids don't know what science is, teach kids everyday science

Why do you feel it is important to encourage STEM to children?

- Teach kids and get them to look at the natural world
- Unaware of science in their lives, science is not just in the lab
- Show kids how/ where things (ex. Food) comes from

In what ways does outreach enrich the curricula of local schools?

- Not everyone learns in book, it's a new way of learning
- Hands on important, seeing →feeling = more important
- More senses you can use the more you'll remember it

What do you believe defines a good outreach program?

- Working on kids level
- Ask lots of questions make it fun, inquiry based
- Include lots of senses, fun

What are key aspects in a good outreach program, especially with regard to 5 to 12-year-olds?

- K-6 level range
- On level, engaging, inspires, multiple senses, fits frameworks

What kinds of programs have you been a part of for this age range?

- Outside of EcoTarium
- Seagrant – www.noaa – marine science/ marine biology/ science outreach, CGrant
- Legislature

What steps must be taken for an institution to create an outreach program?

- Team of good dedicated people (fun interesting crazy)

- Money
- Know audience and what it is looking for

How long does the typical development process take for a new outreach program?

- Depends on audience
    - Types of programs
    - Goals (1 or multitask)
    - Time frame
    - Grade levels
    - Subject/cross curricula
    - Several weeks to several yrs
    - Loaded? NSF grants

How do you decide what topic/ activity to create a program for?

- Know who audience is and what they are (EcoTarium)
- Know self/museum
- Co-member of Historical Association (Worcester Museum)
- Interdependent/ cross-curricula everything is intertwined
- December (science and art exhibit)

Do you ask the public what they would like a program on, and if so how do you gather information on what type of outreach program the public would appreciate?

- Know demographics and history
- Survey people at the museum, survey monkey, members (members weekend)

What steps must be taken for a small museum to create youth programs?

- Define audience
- Resources
- Your niche
- Development marketing/ idea development
- Seaweed pudding

How do you advertise your outreach programs?

- Pamphlets/ rack cards brochures, websites, go into community (schools, festival days), radio, fewer good programs that repeat →customers come back, customer service, public activities, be dramatic

How important is volunteer support for small museums?

- Absolutely essential
- Can't do what EcoTarium does w/out volunteers
- 130 volunteers match up talents w/what have to offer, develop training programs? Get them involved w/ their ideas
- about 30 staff at EcoTarium (2/3 people in programs)

How do you get volunteers?

- Go out into community and get name out there, interested people will come
- Not all volunteers want to do each job
- Match talents with interests

- Develop training programs
- Bring ideas/ownership

Do you use volunteers for your outreach programs?

- Yes, museum staff and volunteer, represent EcoTarium
- Sue and a volunteer go out into community and represent museum also work with community service organizations
- Visit colleges and community service organizations

If so how do you get volunteer support?

- Databases recruit volunteers, colleges, united way, volunteer match, volunteer solutions, High School and senior center
- What worked/ what didn't
- Get people to volunteer, advertise
- On call staff during business, signs on local hangouts, chamber of commerce, ferry signs? Local net? Library, airport

OTHER

- Nantucket Public Schools
    - What they need and are lacking
    - DOE website curriculum framework
        - Student demographic
        - Use schools
        - Members then families
- Size – Harvard Museum of Natural history – 500-1000
- Carnivorous plants/ polar bear/ otter, kits?
- Ave age 4th -5th grades
- April→ June busy season: 500-100people/day
- Inspire children to look around at natural environment
- Change exhibits every 3-6 months

Utilize field trip planner brochure which describes including costs broken down by age groups, includes a list of what MA education standards are associated w/ each program

Appendix C-5: Bob Kennedy Interview Notes

- New goal
  - Which ideas do you like from us?
    - Ideas stood out – mock ups work both ways bring and go probably work better going to schools no hassle with the busses
    - Bring people to museum or go to schools to test prototypes
    - better @ school cuz @ museum = extra work for teachers
    - Points of disinterest became interesting through tours
    - Prototypes to them
      - Extra work to bring them here

  - Your vision of the Natural Science Museum
    - Has exhibits that rep Nantucket and the biodiversity of the island conservation, preservation the history of the island and geology relating to the visitors part relating to Indians up till white men came could do a lot more on the geology wet sands grasslands don't have anything dealing with global warming
    - Doesn't have problem w. astronomy in NSM
    - Focus on Nantucket!!!!!
    - Evaluate the exhibits
    - Brainstorm- interpretive tour and eval. – free tour and eval?
    - Has exhibits that represent the biodiversity of Nantucket as well as concerns the island has(global warming, rising sea levels) teach island about geology in a way the ppl can relate to
    - Rarest habitat on island= sand plain grass lands
    - Don't have anything on global warming and its impact on Nantucket
    - Exhibits that represent Nantucket and its biodiversity, rising sea level, erosion concerns, global warming (recent geology)
    - Native Americans → Europeans
      Sand plain grasslands (rarest habitat)

- Janet: incorporate astronomy into Hinchman?
  - Not against but needs to focus on Nantucket island
  - Question of space
  - Problem is to relate to Nantucket
  - Very little space
  - Focus: Nantucket, not beyond (must relate it back)
  - Evaluation (1-5):
    - Attraction
    - Content
    - Interpretation
  - Present exhibits that aren't working
  - Interpretive tour vs. free choice learning

- Going away? When/how long?
  - Gone from 6th - 10th report to Cheryl when Bob and Janet are not here

- Museum attendance – working on it can distinguish between child and adult
  - Can use given data as a pattern…don't need rest of it

    - data from staff from past few weeks adults vs. children, pattern
- Naturalists around Nantucket
    - Alan Reinhardt
    - Consortium of Nantucket Naturalists (brown bag lunches?)
        - 3rd Tues @ noon (next is Nov. 18th)

- Glacial geology tour (possibly Friday?) –
    - Not Friday

Team meeting - Wednesdays at 10am in the library the 12 /17th meet at 11 am (has meeting at 9am)
Tues Nov. 18th – 5 min presentation on what doing at the brown bag lunch thingy
MMA website for events like mushroom walks

- Rate exhibits ourselves, maybe get public to do same
- Interpretive tour vs. free walk tour
- Team meetings w/ sponsors and Elmes
    - Weekly Wednesday @ 10AM in Science Library
    - Wednesday, Nov. 17th @ 11AM

Appendix C-6: Darcie Vallent Interview Notes

- Contacts:
  - Lighthouse school contacts = Good for whenever
    - Pre-K through 5 (85 kids)
    - Will provide a van
    - Should we meet with teachers there?
      - Not going to get curriculum ties from private school
    - Structure of visits
    - Dates/times
      - Possible grades at a time over a couple days
      - Recommend teachers - not familiar w/ a lot of the teachers could offer programming
      - Week in advance
      - Two classes @ once
      - Over several days
  - Boys and Girls Club
    - Thursday afternoons
      - 3:30-4:30PM
      - Every Thursday
      - Send release to Darcie who will send to program
    - 30 kids
    - Release sent home through program
      - Group of 10 every Thursday= most convenient time
      - Send release to Darcie who will work w/program director to arrange couple week notice
    - Most representative of island
    - 30 kids
    - Provide transportation (van)
    - Send permission slips home w/ kids
  - Girl Scout troop
    - Mom of home school group
    - Will be getting email
    - Daisy = 23 kids
  - Unique Nantucket teachers
    - What was project about?
    - Pub school teachers can send email
    - Terrible at doing what asked
    - 12 teachers
    - project was grant to pay teachers to write science programs to connect stem w/ local field trips
  - Nantucket New School
    - 15 Nobadeer Farm Rd
Nantucket, MA 02554
(508) 228-8569
    - doesn't have transportation better to arrange to bring prototypes to school
    - Matt Liddle- teacher but need to work out with principle (mliddle@nantucketnewschool.org (8th grade science)

        - Davis Provost – head master
        - Good selling pts? – if can come out it's a free visit; helping community
        - 110 kids in school
    - Public schools → Darcie has connections but unwilling to talk to them
    - home schooled groups (pre-K)
        - not representative of island
    - Contacting schools
        - Arrange time after school
        - Visit
        - Set parameters
            - By grade
            - By subject (science/math?)
- Meeting with teachers
    - Set up times after school
    - Set parameters:
        - Grade
        - Discipline (science teachers)
        - At least 3 weeks lead time
        - Email best way private school better
- Classes at MMA during our stay
    - Weather Wizards (Sat, Nov. 8th: 10:00am-12:00pm) – shouldn't conflict doesn't expect to fill up
    - Getting Ready for Winter (Tues, Nov. 11th: 9:00am-3:00pm)
    - Natural Ornaments for the Holidays (Sat, Dec. 6th: 1:00pm-3:00pm)
    - World Class Birding Experience at Eel Point (Sat. & Sun., Dec. 6th & 7th: 2:30pm-5:00pm)
    - Monday and wends after school 330-430 after school program and Tues. morning 9-11 pre-k
- Museum field trips
    - Don't do them right now
        - Nothing for programs to build off of
        - Museum is usually shut
        - Whole room on birds, whole room on plants
    - What would you like to see
        - Interactive
        - Touchable
        - Make own conclusions
        - Learn about things they see outside
        - Each exhibit has space for classroom
        - More program oriented exhibits
        - Variety of subjects
        - Broken down into habitats – add nice flow to museum
        - Concentrate more on land than on marine, move marine to aquarium
        - Keep astronomy out

- School t museum
- Mitchell house
- Don't use museum
- All programs are interactive and try to be done in the habitat
- Only uses program animals

- Ask Sheryl about the summer visits
- Spaced used for teaching
- Would be great to have open for trips
- Idea – have similar more to MOS touch make conclusions learn about what seeing outside each exhibit area having things beyond just seeing
- Working w/ exhibits not limited on subjects
- Rooms on habitats good idea flow museum to programs

Also see museum concentrate on land marine and astronomy to its own places not mixed in to NS
Currently working to get star lab like the MOS Boston
Boy and girls club 508-454-1462 email not great
NPS
Money about getting kids out
Trips have to match classes
No principle teachers don't stay long can't afford it
Stay on top of it

Appendix C-7: Gary and Vladimir Interview Notes

- How long w/ MMA
  - Vladimir- 12^{th} yr, appointed position of Director of Astronomy Dept. (includes astro. research and teaching)
  - Permanent REU site- most research is associated w/ some REU project
    - Some get PhD level
  - Public outreach
    - Grants from NASA for interactive program for kids
    - We should take a look at this
    - Original solar system model for adults
    - Open nights – adults and special for children
- Incorporating interactivity in Hinchman
  - Don't know
  - TV/ computer should be utilized
  - Prompt questions and give answers to motivate visitors
  - teach lift force – common between plane and bird
  - migration – navigation
  - bionics – how do humans learn from animals, what technology is derived from nature
- layout of museum
  - given small space, cannot separate into section
  - instead clever mixing of topics w/in same room
  - missing exhibit on evolution (maybe a timeline) – start at big bang and end in civilization (maybe painted around room near ceiling) bridges natural science w/ astronomy
    - could also end in the search for extraterrestrial life
- unique to Nantucket exhibits
  - emphasize habitat of many species, historically astronomical island
- utilize ceiling space, hang birds from ceiling

Can include astronomy or not
Vladimir – 12yrs appointed advertisement won job director of astronomy dept
    2 observatories exhibits and research 95% REU and teaching students permanent REU site
    wins grants 100 applications and 6 positions
tours of exhibits and observatory building and lawn solar system model – kids love it
original model of solar system for adults partly projected – present solar system on scale
may come only to observatory tour once a day private tours etc
Hinchman
could include astronomy
not know about interactivity and biological not going to give suggestions
YV should be used of course maybe computers QA in which visitor is involved
Students should be able to describe how bird flies etc common between airplane and bird
Migration of birds and how a bird can find exact location over and over
Unsolved problem provide 7ral answers answer is close to belief by scientist
How do humans learn from animals ex technology
Ideas for setting up museum
Doesn't think can afford to separate various habitats do to space
Insects and birds together possibly

Nothing really comes to mind
Of course together – missing in NS good exhibit on evolution could start with evolution of stars big bang to civilization band painted around the room? Always wanted more conversation between depts. on evolution
Search for life on other worlds drake equation museum in DC
Feel about bringing Nantucket
Astronomical island
Nantucket special geologically and biologically
Space ideas as ceiling exhibits time lapse movie of changing Nantucket geography where island map is picture of moon w/ Mitchell crater marked - size of Nantucket
Combined astronomy geology and bio
5th and 6th of open night's best time to view MMA crater on moon

- How did you get started here?
    - Has been at MMA for 12 yrs
    - Appointed director of observatory and astronomy dept
    - MMO refers to both observatories
        - Maria Mitchell Observatory on Vestal
        - Loines on Milk St. ext
- Department includes:
    - Astronomical research
    - Teaching via research
    - Permanent REU site
        - Certified w/ NSF grant for several years (usually 5 or 7)
        - 100 apps → 6 accepted (very competitive)
        - 75% published in peer reviewed journals
        - Research topics
            - 90-95% research associated w/ REU program
            - Not related to personal research
            - PhD level work (often is the case) done by undergrads
- Public outreach
    - Tours of MMO
    - Grant from NASA for interactive show for kids
        - Look @ model ($10,000)
    - Original adult solar system model
        - Unique scaling problem
            - Orbits are not perfectly round/elliptical/even
            - Inner planets vs. outer planets
        - One tour per day in summer
    - Loines open nights
        - Adults only
        - Children's nights
            - More accessible
            - Pay more
    - Private tours
- Ideas for Hinchman House
    - Astronomical artifacts
        - Incorporate in HH
        - Excellent microscopes in HH and Aquarium
    - Weightlessness (weight on Mars)

- TV usage
- Computers
- Questions & answers -> draw conclusions
- Assess whether child may tell how a bird flies after exhibit
- What is lift force?
- Commonalities between bird & airplane?
- Make questions accessible to all ages
- Migration of birds
- Navigation over years
- Several answers to choose from (connect to scientific findings)
- Comparison to insects (butterflies)
- Bionics = using nature to engineer something
    - How do humans learn from animals
        - Fisheye lens
        - Helicopter ← dragonflies/hummingbirds
        - Energy loss (inverse ratio of surface area to volume)

- Setup
    - Small museum/not much wiggle room
    - Do not separate by room
        - Intelligent/provocative blend/arrangement
            - Insects & birds → prompt questions
    - Blend natural science w/ astronomy?
        - Good exhibit of evolution
            - Comes from the stars
            - Timeline of evolution: big bang → civilization
                - Wall/band of evolution around rooms
            - Collaboration based on evolution (intimately related)
                - Search for extraterrestrial intelligence (SETI)
                    - Mars
                    - Vladimir worked in astronomy museum
- Nantucket specialties
    - Habitat of many unique species
        - Astronomical island (window)
    - Geology info (Bob/Cheryl)
    - Ceiling exhibits
        - Models of spacecraft
        - Interactive rover for kids to play in (Gary)
    - Nantucket = pile of sand
        - Geological changes (movements)
    - Maria Mitchell crater = same size as Nantucket
        - Excellent picture in MMO
    - Bridge to show material unity in nature:
        - Astronomy
        - Biology
        - Geology

Appendix C-8: Janet Schulte Interview Notes

- Shorten the Goal and Objectives of the project

  - To update the Natural Science exhibits to encourage schools to come to the museum
    - Interview teachers
    - Interview sponsors and staff
    - Research other museums
    - Observe kids at the MMA, or schools if necessary
    - Build prototypes
    - Test prototypes
    - Recommendations

  ^Sounds good^
- Open house event of some sort
  - Will get loyal parents (perhaps a dozen from Janet)
  - Saturday/Sunday for this event
  - Attract families

  - What do you believe the focus of the project is?

- What needs to change in MMA Nat Sci Museum?
  - Not free-choice
  - Need to know something to get anything out of it

  - What do you think the MMA NSM needs the most to improve for the goal?
    - More touchable exhibits
    - Bring in more senses – bird calls in the bird room, etc.
    - More hands-on activities
    - Increase visibility – tie to curriculum
    - Video maps/ video showing how island changes/ was formed
  - Bob geology tour of the island talk to him about his ideas consortium of Nantucket naturalists
  - Currently raising money for a budget for architects etc.
  - Andrew - museum how to become a collector will give use email
  - More appeal to the senses:
    - Sound → CD-rom (bird calls)
      - Touch/taste
    - Sight → video
      - Change in Nantucket's geology (glacier → current island)
  - Human ecology
    - Native history
  - Collaborative events
    - Meet w/ other island museums (NHA?)
  - Each room = habitat
  - Incorporate astronomy?
    - Maria would have seen it as all being connected

  - What goals do you think the NSM needs to achieve?

        - See above question
        - See recommendations for collaboration with NHS interactivity sound and manipulations increase its visibility make sure each room has a frame work map maybe try to integrate the astronomy exhibit info into the museum
        - Senses
        - Interactivity
        - Increased visitation
        - Frameworks (for interns next year)

    - What is the best way to get in contact with Bob?
      Cell phone – 577-4105
    - Who in the MMA is best to talk to about setting up visits and activities?
        - Speak to Rachel first
    - What do you believe is the best way to advertise for our events at the MMA?
      See Rachel
      Rachel will have thoughts and expensive calendar listings and ecomet newsletter backpacks
      Rachel's Comment– in conjunction w/our working have free open house where we observe and they provide suggestions sending newsletter out early next week talk to Darcie about sending stuff through backpacks
- Where may we find visitor data?
    - Guest book in Hinch from this summer (most kids are 4 in summer)
    - Feedback from journal this summer
    - Visitor stats (excel doc)
    - Bob working on completing doc
- Suggestions from Janet:
    - Conference call w/ Andrew McKenna Foster (director)
        - Collection strategies
    - Bob's glacial geology tour
    - Speak to Alan Reinhardt
        - Naturalist (knows Bob)
        - Consortium of Nantucket Naturalists
            - 3rd Tuesday of the month (November 18th noontime)
        - Other lunch events: NHA Thursday noon meetings
    - Speak to Judy Lee (fmr. director)
    - Interview Vladimir & Gary together
    - Read through brochures to get a better idea of MMA and its programs
    - Bob can most easily be reached by cell: 508-577-4105
      Distribution list by email to acquaint us w/ other staff
    - NOTE: Develop new timeline for updated goal – dates that the MMA is busy/breaks etc.
- Schools - Darcie
    - Superintendent of Public Schools
    - Private Schools
        - Nantucket New School K-7
            - mliddle@nantucketnewschool.org
        - Lighthouse School
            - See Darcy for contact
    - Home Schools
        - See Darcy for contact

    - Steps to arrange dates for school visits with the MMA
        - Saturdays most likely talk to Darcie about activities and things going on
- Tomorrow going to RadioShack to get a digital recorder interviews
- Talk to bob and Vladimir about incorporating the astronomy exhibits in the NSM
- Ask Bob about geology tour
- Human effect on island
- Consortium of Nantucket Naturalists – 3rd Tuesday of the month
- Recommendations for collaboration
- Ask Bob and Vladimir about incorporating the astronomy into Hinchman house

Darcie's Comments:
- Have to sign release 8th – hockey tournament all day event people looking for things to do veterans weekend
- Advertise to the school
- Solidify by late weds or Thurs. to put in papers
- Have brief survey or something so that visitors can give feed back since they know project going on attendance implies release forms at main office if kids coming w/ baby sitters
- See if can use Elmes to hand out release at door
- Light house can come out just need to know 80ish when, home-school- pre-K 5 kids have send email to new school haven't heard back has girl scout troop
- Boys and girls club Thursdays send forms through clubs possibly most representative 30ish
- Unique Nantucket teachers- grant from MMA curriculum based on MA standards
- Talk to teachers arrange time AS give parameters (grades etc) talk to Darcie about when want meeting weeks in advance

Rachel's Comments:

Rachel is in charge of PR (rrasfeld@mmo.org)
    - Will arrange open house for us
        - Free (no cost)
            - Because of observation/research opportunity
        - Feedback:
            - Suggestion cards
            - Surveys
        - Time slot
            - Events usually 6 hours
            - We can shoot for shorter
        - Parental consent
            - Parents only!
            - No babysitters
            - Door person collecting/administering forms (advisor)
    - Nov. 8th because of hockey tournament (Darcie)
    - Publicity
        - Calendar listings
        - Newsletter
        - Book bags from school

Appendix C-9: Andrew McKenna-Foster Phone Transcription

Note: December 3, 2008 6:30pm (43:56 minutes)

Alex: We have a couple of questions to start off with.

Andrew: OK.

Molly: The first question is what do you believe the current goal of the museum is?

Andrew: As it is currently?

Molly: Right.

Andrew: Well currently, the way it's laid out and the way that we have our tours set up is to introduce people to the natural history of Nantucket and the ecology of the island. It also acts as a way to get people interested in going to the middle part of the island and get them away from the beach a little bit. It really has become more of a… something that's really focused on kids and trying to get them interested in learning about plants and birds and insects and mammals of Nantucket and then through them getting to their parents. Really physically, it's the display case for what Nantucket is, what can be found on Nantucket and where it can be found.

Victoria: What do you think it could be?

Andrew: That's the big question, huh? In my mind, the way I see it is a place where people would come just expecting another museum but we're hoping they leave with an entirely different outlook on the island. From my five years there, when I first arrived, I had no idea what the island was like and what was out there. After working at the museum for five years, I have a totally different perspective of the island. Unique in the word everybody uses with Nantucket but it's really true, that it is a really unique place. I see the museum as a place that could become a natural community center. Right now we get a lot of visitors who just come for the day or for the weekend or even summer clients. We don't see a lot of people who actually live on the island. A lot of those people don't come by too often. I think it should be a place where those people come by all the time. People find something there that they want to find out what it is, bring it by the museum. I think that's the biggest part, trying to connect the museum with the actual community living on the island. It's a big thing. The other aspect of course would be doing a much better job of getting people to interact with the geologic history, botanical history, and then the zoological history of the island. Getting them to find out where to go to see certain things: the bets place to find rocks, the best place to see birds, and then learn about – 'cause it'd be great for people on the island to be like "Oh yeah, we're standing on the glacial moraine right now. If they actually knew where there's a central place on the island. I see that the museum could be that place along with all of Maria Mitchell as well.

Alex: OK.

Andrew: A little convoluted per se.

Victoria: You mentioned that you worked at the museum for five years. How did you start at the museum and what do you currently do?

Andrew: I started as an ecology intern. I actually started thinking I was going to be the herbarium intern. Working with the herbarium, putting all the data in an Excel sheet and all that. But it turns out that I got more involved with the American Burying Beetle project, reintroducing the beetle to the island as well as everything else… you know, being taking part in the aquarium activities, children's classes and doing all the astronomy stuff as well. Then I came back for two summers after that in the same position as a college intern. We really got the museum tours going because people who walk through the museum, nothing's connected. There's no transition between the rooms and there's no overarching theme really that people could pull out immediately. It's really just one of those little old places that people are like, "Oh, I found this great little place! You know, it has a bunch of old things in it. It was cool to look at," but they never come away with any concrete idea of what they just learned about. We try to do that through tours now. It's kind of like forcing people to understand what they're looking at. You know there's staff changes at Maria Mitchell and obviously now my title is director of the museum. What that entails is I get the museum interns going on different tours and then I also help them work on research. That's a big part of the internships. Also a big part of the museum is coordinating these research activities, collecting specimens from all the research on the island, other organizations as well. It is the storehouse for the biodiversity initiative on the island. Anybody who collects anything on the island really should give us at least something about their collection, what they collected. At the very least, something they identified so we can put it in the museum at some point and store or possibly even display it and stuff like that. Most of my time, it's actually fifty-fifty. Half of my time is total research and then the other time it's displays or getting to reach the public.

Molly: You mention the tours that were given.

Andrew: Yes.

Molly: What are your opinions of the tour? Are they good? Are they bad?

Andrew: Well, it totally depends on who's giving them. I didn't go to school for museum science or curation or anything like that but I wrote out the tour based on what I would end up telling people if they came in the museum. The problem is that it totally depends on how the intern, or whoever's giving the tour, feels about it. You know, if they're really gregarious people or have no problem speaking in front of people then it can be great. Especially if the people getting the tour are really interested and they ask a lot of questions, it could be really, really fun and engaging. But then sometimes you get new people who aren't really interested. They just want to look around but then they spend literally two minutes in the museum and they just paid five bucks. We feel like we have to force them on to these tours and the problem is you feel a lot of weight on your shoulders trying to convince people that the displays are cool, that these eighty year old birds are something that's worth them looking at. Doing that ten times a day can wear you down pretty badly. On the other hand, some days it's just fantastic. There are kids in there and they're super interested or they like something and they spend two hours to look at everything. That's when you really realize that it can work but it needs a lot of fine tuning. It would help if the museum would help with that. Provide a path for people to follow on their own so they don't have the need for personal guidance through the whole thing. It'd be great if we could just wander around and answer questions haphazardly, randomly. But right now it's a very important part of the museum. What did you guys think when you first walked into the museum?

Alex: First of all, I was surprised by how small it was but that's because I've only been to big ones. When I heard about the tours I was very surprised that so many people, from what we've heard, take the tours. People expect the tour. It's very counter-intuitive to what I thought and what our research said is the typical type of learning in a museum. We were reading in all these sorts of literature that the main type of learning that goes on are the ones where people could roam around and only look at what they care about. To be ushered around seems kind of counter-intuitive but after looking at the museums ourselves we were like, “Yeah, it needs it.” We’re hoping that we can make some recommendations to the MMA so that it doesn’t need it and it can be more like a normal museum. So people can look around and still learn something on their own.

Andrew: Yeah, that’d be great. I mean that would make the whole experience better in general. Definitely some people don’t want tours, you know? They don’t want to have to interact with somebody who feels like they know about the natural world or something. On the other hand, it is great being a small museum that—people enjoy interacting with the interns: “Where are you from? Are you in college?” You could be telling people about spiders or beetles, telling people about seeing birds. This way it would be great to have a hands-on, behind the scenes kind of thing where we could do actual research in the museum setting. There are always people who feel like asking questions and the people around them, who are more shy or whatever, definitely benefit. They definitely get sucked into those connotations from overhearing it. Right now I just don’t feel comfortable all the time being like “Welcome! Just come on in. You’ll find everything you need.”

Alex: Because they won’t.

Andrew: I really feel like I need to help them through the museum.

Victoria: You mentioned that you wanted to do research in the museum. What do you mean by that?

Andrew: I don’t know how you guys see museums but seeing that there are always these displays and with information clash, all that. Museums are good storehouses of information and specimens but for us it’s also our laboratory. I do a lot of work with spiders and I have to have a collection of identified spiders that I could constantly check with to make sure that I’m right in my identification and all that stuff. That’s why the museum is so important. In every research, research is really tied with the museum. All the specimens go to the museum. During the research, people go to the museum to check on things. It’d be nice to have an area where we could do bird skinning, insect pinning, or just identification. Set up a microscope that people can look through and see what we’re seeing. That’s the kind of research I’m talking about as opposed to things such as behavioral research and stuff like that. It’s full of potential. You’ve probably seen the black widows.

Alex, Molly and Victoria: Mmhmm. Yeah.

Andrew: That’d be a good display, you know, and people could learn about behavioral studies and all that stuff.

Victoria: Janet sent us a copy the future plan for the museum. In that, you mention research spaces. In these research spaces that you mention, is that kind of what you want? Do you want a table out in the front room where people participate in the insect pinning and that sort of thing?

Andrew: Yeah, it’s interesting to hear what you all think of that. In the summer time we have someone sitting at the desk. People usually get lost in town or they come up Vestal Street looking for the observatory or the aquarium or the old jail, which is down the street. They automatically come to our back steps there. They come in and they’re like, “Oh, what’s this place?” or “Is this the observatory?” We tell them no and we convince them this is a museum. It’d be great if those people walk in and instead of seeing just a gift shop, in the back they could see somebody doing something. I think that would be a good draw-in at least. I don’t know if people hate insects or something. They might not like that. At least the space, we can use that occasionally. It'd be useful elsewhere in the museum, too, like in the animal room. Sorry I'm kind of getting lost in my thoughts. I think that a place where we could set up a microscope to have electricity, a sturdy table, some storage units that we could lock so that we could keep stuff there when nobody's using it. People could pull chairs to it if we were doing an insect pinning class or something like that. During education, when classes come in there and use that space, they usually have to set up something in the gift shop. You know, it'd be nice to have a place where they can use that to do their artwork or whatever.

Molly: What are your opinions of the current exhibits, as they are now?

Andrew: I think that it's really important that, whatever happens in the museum in the future, it keeps at least part of the feel of walking into a really old time, like1800s preserved specimens, old time museum. And that's really the museum's biggest strength right now. People walk in and it's kind of an oddity. The current exhibits are great. We have some really good specimens, amazing specimens in there, but they just aren't connected in any way. They're just sitting there in a case or something. They don't have a lot of good information with them. People look at them and they don't know what they're supposed to take away from it. So in that thing I wrote up about museum organization, I was just writing down thoughts. The only theme that I could think of that really could use everything was the theme of an amateur naturalists training center. You know, it's like a museum of amateur naturalism, a place where people could practice that, learn about it and get better at it. I think with that you could—all that stuff was done by amateur naturalists. What do you think? That seems like the best way to connect everything but I don't know what other museums do actually.

Molly: Of the current exhibits, are there any of them that you think work best at getting their point across?

Andrew: That are best at it?

Molly: Yes.

Andrew: Well you know that map table, the bathymetric map with the island and stuff and the sea difference? That is incredibly useful for describing how Nantucket was formed by the glacier. People like looking at that and go "Oh look, we live right here" and "Look how deep it is out there" or "Look how shallow it is." They use that to ask questions about where things are or where we are. We incorporate those things when we answer them. It's a really simple exhibit but people look at that a lot. Of course the dolphin skeleton. Kids love that. Parents love pointing it out to their kids. Then the sea life quiz game, that's something that's right at the right level for most of the kids that are coming in the museum, the littler kids who don't have much else to look at or really entertain themselves with. That's perfect for them and that's why it's in such bad disrepair. It breaks every summer from overuse. In the bird room, they like looking at all those birds. The nest exhibit is a cool exhibit. People are immediately drawn to it but then they almost immediately lose focus on it 'cause there's nothing to help them out with it. Then in the General Ecology Room, the room with the geology maps hanging on the wall, there's the exhibit of what goes on in a museum. That's the first room that we take people into. That exhibit that has a dead cardinal, a hare, a compressed plant always grabs people's attention. They always look at that. The parents point out to their kids, "Oh, it's a dead bird. Look at that." That's a great conversation starter. I think the map and that exhibit are probably the two biggest. Then of course, the biggest is the live animal room. The animal room is where people spend most of their time. Do you guys have a copy of the tour that we usually give to visitors?

Alex: No but Cheryl's given us a tour.

Andrew: OK well, do you have a written copy of what we usually talk about?

Alex, Molly and Victoria: No.

Andrew: No? Oh, OK. Well I'll send that to—whose email do I have at the moment? Do I have all your emails?

Molly: No, I think you have mine.

Andrew: Well I'll send a copy to you, Molly. I'll let you take a look at that. It just has more information in it. I don't know if it'll be helpful.

Alex: Thank you.

Andrew: Did that answer the question? I feel like I'm just rambling here.

Alex: No, you're helping.

Molly: So which topics do you believe aren't represented enough in the museum?

Andrew: Well I think that the museum is really specimen-heavy. It doesn't have a lot of things to connect it. It's missing the idea that would connect everything together, like why is geology so important? We need something about that, something written with pictures that people are attracted to so they could do independent learning. The same with general ecological principles. I'll see if we could try this out next summer. There's a game, you know like Jenga where you build a tower?

Molly: Mmhmm.

Andrew: Instead of just pulling out blocks, you're pulling out blocks that are representing either wetlands or predators or herbivores. It illustrates that if you remove these things from an ecosystem, it becomes weaker and starts to crumble. You relate it to man and removing habitat. Specifically, what it's really missing is an easy way to—we don't have a good way of describing what is in the display cases. I don't know if that's what you were asking about but if we had an easy way to do that-- The thing is, we need to be able to change it every once in a while. I think with any museum, there are several core exhibits, and then there are places that get switched out every once in a while. The thing with this museum is that it probably needs to be switched out twice a summer or something like that. We would need an easy way to do that so that maybe we could get people to come back at least twice. People that were here for a month and a half or something like that come once like, "Oh, I've been there." We want a way to get them back in again. I think the way to do that is to be able to switch up our exhibits. That would just make it easier. You could put specimens in one exhibit and just have some way of easily putting in information classes. Does that answer your question?

Alex & Molly: Yeah.

Andrew: I can't think of any specific exhibits really. It's all kind of represented by the specimens but it's not really working well.

Victoria: When you talk about changing what the museum has to offer, changing up exhibits once in a while, would you be changing by theme or would you just be changing so it would be a change of pace?

Andrew: Changing the theme or… what was that last thing?

Alex: Or a change of pace.

Andrew: Oh, change of pace.

Victoria: Would you just be changing it to change it or would you change it so that it fits a new theme?

Andrew: I think we'll just change individual exhibits within the same theme that they're in. The live animals, that's just easy. You could always have a different assemblage of live animals. In the other rooms you could customize it with whatever was happening that summer. A couple of years ago, it would have been nice if we could have a place where we could have done global warming things. We could update with the current findings and the current happenings of global warming to be and give people good information. It's surprising. A lot of people come in and bring up global warming. They'll ask about it and whether it's really happening and that stuff. That'd be a good useful, current events display. The way that I wrote up the design was by habitat rather than plants and geology, and such. Each of those, there are things that are happening today, new science. They just found that there was probably life on Earth way farther back, way earlier than we'd ever thought, like four billion years ago instead of three billion years ago. That's something, like an exhibit about how far back did life exist? It's all within the same theme: keeping people current on the scientific. Also, when interns come in they always have their own interests. It is amazing how much time it takes to build a display. It's just so time consuming but I always try to get the interns to at least work on one, try to rewrite one or think up a new idea for one. It'd be great if they would have space and some guidelines on what they would need to write, how they would need to design something so that it could fit in this already predetermined space.

Victoria: Do you feel that because this is a small museum, there is a greater chance that you could do that, you could better reach the public by changing it up all the time? Does it give some kind of freedom?

Andrew: Yeah, I think so. Also because a lot of the kids' classes— that's a big thing for Maria Mitchell, these kids' camps—a lot of them are at the museum, some end at the museum so parents pick up their kids there. They come into the gift shop and they check it out. They're there many times during the summer and it'd be nice to have them, without even realizing, say "Oh, this changed. Cool." It just gives us more opportunities to hit on people's interests. I think that we can do that because it is a small museum. I don't know that we could have a higher number of staff to square footage. Other museums get more man-power. People walk through the museum and—so you've been there twice and you feel like you know what's going on. We do that now a little bit in the live animal room. We'll publish in the paper that we just got a bull frog. It brings people in learning that there's something different going on.

Molly: In the future updated museum, what types of exhibits would you like to see? We know we talked to some staff members and they want to keep the old feel, some people are like let's go crazy and make it like some of the children's museums like in Boston with tunnels and the world blown up to kid's scale. What do you see for the future museum that way?

Andrew: That's a tough area because it really seems like in museums, at least small places like this, you really have to gear it toward kids because parents are always looking for something to do with their kids. Unless you're in New York where there are these adult-themed museums that are really good, we don't get a ton of adults going through the museum on their own. There's definitely a group, like a couple on vacation on a daytrip and they're interested in the cultural activities on the island. They'll come by the museum. A lot of times we get people wanting to do something with their kids, trying to keep them entertained. We need to have more exhibits that are kid-friendly. I think that having things that kids can crawl through is great. I think that even adults will crawl through there. I think that would have to be a permanent thing. The museum is kind of like a nature center, museum, and research laboratory. We can tell people where to go for the great fishing, where to go to see birds, where to go for a safe picnic. We're acting kind of like a nature center and I see a nature center having those types of things. There's one here in Green Bay, where I am now, and you crawl through the tree and see a raccoon and larvae. On the other hand, we definitely need to keep all those old specimens. Kids are interested in those, too. That's why I think that the amateur naturalist theme is a good one because kids can practice their observation skills with kids' activities. No matter what parents love being able to show their kids something. If they could quickly read the theme of it, and then they could tell their kid all about it, they love that. They'll learn something about it to. I know that doesn't really answer the question really at all.

Alex: Yeah, it does.

Andrew: I think both sides are right. It's important to keep it the way it is in a way because a lot of the islanders have grown up with the museum the way it is and it really hasn't changed that much. We'd do the island and this museum a disservice if we totally eliminated that. It's actually kind of impossible to eliminate that because the museum is so based on its collections which are automatically the old feel. I think that having kids' exhibits is definitely something that should be done. We definitely have to focus more on kids. We need to have more things for kids to do and look at and learn about.

Alex: Because of the space limitations and since there's just very little space to work with, if the museum was to incorporate more kids' places, what are the weaker exhibits you feel wouldn't be as missed so much? Which ones aren't getting their point across?

Andrew: What could be removed to make room for other things? You know how a lot of exhibits, we have a lot of tables in there?

Alex: Mmhmm.

Andrew: They're sprinkled around the museum and they'll just have some things on them or we'll have a bench. In the sea life room, there's a bench with part of a whale jawbone and a whale skull. I think those could be displayed in a different way. The whale skull could be on the wall. The jawbone could also be on the wall. It would take major hardware and stuff but that would free up that whole space down there for whatever and it's a perfect area for kids.

Alex: Alright.

Andrew: There's a lot in the museum that I think it doesn't have to disappear but it could be…

Alex: Relocated.

Andrew: Relocated, or put with other stuff. Definitely in the bird room, we have just cases of birds and we need to devote some of that space to more information and things that capture kids' attention. Some of that space needs to be turned over to other exhibits. That's a good place for more evolving exhibits like all the bird specimens we have. We can change that from tweeting birds one month to birds of prey. I can't really name other specific ones. As you're looking at this, don't feel like there's certain exhibits that you have to keep. What ends up happening is we move stuff around a lot, too. Not the big things but little things we move a lot. Throughout the summer it changes a little bit. I think things can be reorganized, especially if we use the walls more. We don't use the walls very much. We don't have a lot of things on the wall. Don't limit your creativity. I would say, when I wrote this thing, I was thinking about redesigning every exhibit for the most part, keeping what's in them but redesigning the format of them.

Molly: In a redesigned museum, do you think the tour should be something that should stay or eventually sort of be dropped completely and have a museum where people could go around and learn completely by themselves and then ask staff members who happen to be there questions if they have them?

Andrew: It can be fun for us to give tours. Some people do like tours. We do ask people, "Would you like a tour?" People usually wait for a minute and then we say it's really great. Some people immediately answer, "Oh, yes we'd love a tour." So it shouldn't be something that's dropped. If the museum is better organized and set up for people to their individual learning then we'll feel more comfortable just letting people go through and not feel like we need to give people tours. I think that would work out better. I think the list of duties of an intern should be working in the museum, whether that be just doing research work in the museum and then answer questions that people have. I think it's an important aspect. It's such a small museum. The way it used to be was that there was no gift shop. That big gift shop area wasn't there so everyone would come in through the front door. They'd just have somebody hanging around in the hallway where the current research display is. That was their gift shop and little desk area. They'd just have people come in. It was a very low key, very relaxed place. So a lot of people come in like, "Oh man, this place is way bigger now!" It was an even smaller place then. You walk in and you're interacting with the museum staff no matter what. They didn't have organized tours but.

Molly: One topic that you put on the little museum layout that you made for the museum was Maria Mitchell. Do you think that's something that should still be maintained in the Natural Science Museum? Should we try to stay more towards the astronomy and the birth place house and try to have the science museum focus on more on Nantucket and its environment?

Andrew: I don't think it would need to be a major focus. I think it would be nice to mention that she was an amateur naturalist herself. I don't know if you planned out a space for naturalists on Nantucket or something. I think she should be in that. Usually on our tours, we give a brief synopsis of her life in order to get people interested to go to the birthplace if they haven't already. If we had at least something about her right in the beginning, just describing her role in natural sciences.

Alex: Anything else?

Andrew: How's it going out there? What do you think of it?

Alex: It's different.

Victoria: Interesting.

Andrew: Yeah, how long are you working on this project? Is it just a semester?

Alex: It's a term.

Victoria: Half a semester.

Alex: Yes, it's half a semester. We're leaving on the eighteenth.

Andrew: OK, great. Once again, I'm really glad that this whole thing worked out. I'm really looking forward to seeing what you think. Don't hold back in your recommendations.

Molly: We’re currently testing some prototype exhibits that we made and having groups of school children come to the museum to test them so we can see how effective they are.

Andrew: That’s a great idea!

Molly: We have exhibits on erosion and the changing shoreline of Nantucket as well as bird adaptations of the beaks and their feet.

Andrew: Yeah.

Victoria: We felt it was a good idea to add more why to the museum because when we first came here we saw a lot of identification. That’s cool if you’ve seen these things before but if you haven’t seen a giant snow owl outside your window, it doesn’t mean anything when you first come in. You just kind of feel bombarded.

Andrew: Yeah. That’s great. The why is good.

Victoria: It’s nice to look at the bird beaks and say, “Oh, wow! Ten of these birds have the same beak. They must eat the same food.”

Andrew: Yeah, that’s great. Yeah. People hardly ever ask that question. They’re just like, “Oh, whatever. That’s just the way it is.” That’s great. I’m looking forward to seeing what you find out.

Victoria: Thank you for your time.

Andrew: Thanks for calling me. It’s great to hear how things are going. Of course if you have any questions or anything else I can help with, you can email me.

Alex: OK. I wish we could meet you in person.

Appendix C-10: Gillian Myres Interview Transcription

Note: VV- Victoria Valencia
MC- Molly Congdon
AT - Alex Tutone
GM - Gillian Myers

GM: As long as it won't be held against me.

[laughing]

VV: Uh, so you teach second grade, right?

GM: Yup

VV: What kind...uh, oh go ahead.

MC: I just want to ask, um, have you ever been to the Maria Mitchell Association before?

GM: Yes

MC: The hinchman house in particular?

GM: Yes

MC: Um, have you ever brought your class?

GM: Yes

MC: Um, what kind of field trips did you take and inter...have with the Maria Mitchell Association and the Hinchman House in particular?

GM: um, the only field trip we took was directly there and it was like 9 or 10 years ago so you're really pushing my knowledge. But, um, I think actually they had invited the whole second grade and just do an exploration and they kind of showed the area, what was there and what the place has to offer. That's all I remember, it was like 9 or 10 years ago that we did that. And then the other field trips that we have done um recently have been around habitat. So we've used the um UMASS field station, we've used the um bogs out at Squam Swamp, we've used the um Squam farm and I think I might be missing one. I think that might be it and those are all this year so.

MC: Do you have that question you wanted to ask Vickie? [mumbling]

VV: Um no it was more about curriculum and boring things like that so. Their not boring its just

GM: A bunch of the same.

VV: It's exciting.

GM: Different

VV: It’s exciting. Its just we’ve been looking through the frame works today, so it’s all going to sound very similar. Um what exactly are you teaching right now?

GM: Specifically we just finished teaching habitats and we will be sort of taking a break and be working on continents for social studies and um tying the habitats back in a little bit, having students um study animals from each continent so that it connected the science and social studies a bit more. But it was specifically the habitats and then when we get back from break we will do um the simple machines, balance and motion, and then um we get into liquids, solids and gases. I think after February break and then um I may be sounding a little fussy cus I was on maternity leave last year so I’m thinking like ok and then from there we take a break and do biographies for social studies and then at the very end um and I think yeah their the simple machines, I feel like there is one more piece I’m missing, but maybe not. I think that’s it.

VV: It’s really cool that you blended the habitats and the continent thing. I wouldn’t think about that.

GM: We’re trying to.

VV: Yeah

GM: Yeah I haven’t, we haven’t done it in the past, but it just sort of naturally started to happen so...

VV: That makes sense

GM: The Christmas project, you want to see. It’s really exciting.

VV: Christmas?

GM: I’m sure you guys are like really excited about this. I don’t know if you know what this is but these are animals from different continents and then they had to write what continent with the habitat.

VV: ohhh yeah.

GM: And then we are going to take all the continents and have them hang all their animals from the continent and then hang the continents on trees down town for stroll.

VV: nice, sweet

MC: yeah

GM: Very exciting.

VV: So we were wondering, mostly since we’ve been looking at the frameworks and we realized that there are multiple classes per grade here. How exactly do you break up what is being taught at each time because the frameworks are broken up in clusters and not grades?

GM: Right

VV: So do you all come together and say in kindergarten we should get these things covered?

GM: Yeah. So not last year but the year before, they had, the administration had a group of teachers representative from all the grade levels sit down and look at the frameworks and look at what we were teaching currently in each grade level. So for instance if we are teaching butterflies, life cycle, liquids and solids and, I don't know, simple machines to find out where they ran across the curriculum like if they were showing up in first grade, third grade and fifth grade or if they were only showing up once in second grade. So that it was touched upon in more that one grade level but not everyone is teaching butterflies from k to five so we took the maps and looked at them um cross grade level and if there was something that wasn't being taught enough or was being taught too much we adjusted it as a team of teachers and modified like that.

VV: O.K.

GM: Does that make sense?

VV: It makes a lot of sense.

GM: Was Girv this serous when you sat down with him?

VV: Well he had his child running around, so I think he was trying to be.

GM: Well yeah.

[Laughing]

GM: Well I have to get mine two in like twenty minutes. Will it take that long?

[Chorus of No's]

VV: We wouldn't want to keep you from your child. That would be awful.

[Laughing]

VV: Do you believe that a trip to the Natural Science Museum would be helpful to your class at all. I mean if you could start over or at anytime, not necessarily right now?

GM: Yeah, absolutely. There are a million ways we could tie stuff in for sure.

MC: Why would you be interested in taking your class to the science museum from what you can remember it being?

GM: It would just be another hands-on experience. Another, um, other people would be there. So different instructor, sometimes that, you know maybe I'm not getting through a child that is just sick of hearing me go blah, blah, blah. You know what I mean or maybe they just have a different way of interacting. Um, the tools and materials may guide somebody's interest. There are a million reasons that it would be a good idea to go: um, being out of the classroom, different materials to offer, maybe sparking my interest and being able to guide their discovery more; tons of good reasons.

MC: Do you think the natural science museum incorporates enough of the science topics, from what you can remember?

GM: From what I can remember? Boy you’re pushing it there.

[Mike Girvin interrupts briefly returning the informed consent forms.]

GM: Um, can you restate the question? I got completely side tracked.

MC: O.K. well maybe to help refresh your memory. Right now the science museum has four main rooms and then another room that has part gift shop and a main part where they do activities. There is a room full of taxidermy birds. And there’s...

GM: And a stair case, I remember.

MC: Yeah and there’s the marine room which has some whale bones and a um, not a topographical map it’s the… when it sinks, I forgot the name right now.

GM: Yup

AT: Bathograph

VV: Bathometric

MC: But it has that with the island showing the currents around it, a whole bunch of shells, there’s a shell matching game. There’s the live animal room with the snakes and the turtles and all the spiders. And there is a general ecology room that has…

AT: That has, the main attraction there is owl pellets. And, there is some, during the summer there are some live, living plant things.

GM: O.K. Can you say the question again?

MC: We were wondering if you though it incorporated enough of the science topics that…

GM: That we have to cover in second grade. I mean I could definitely tie in the habitats, um fossils. We have to identify in which the organisms habitat provides basic needs so we can tie that in by just observing the animals that you have. Definitely, and didn’t, I think you actually, there used to be boxes there as well that um we could check out. I think.

VV: Boxes? What kind of boxes?

GM: Boxes like, this is going back seven or eight years now so I could be going crazy but, they had a whole bunch of stuff on fossils for instance. And it was like a little kit and you could sign it out and it had a whole bunch of materials for classroom teachers to use. And it may have outlined a project, like maybe hiding animals inside sand and maybe having students pretend that they are archeologists and uncover them. I remember that being one of them. And there was something with cracking open an egg and finding something inside, maybe the geodes or something. Its really sketchy, but they there used to be. I’m pretty sure they used to be there and teachers could sign them out.

AT: We never heard of anything like that?

GM: Check in with somebody. I'm sure if you say it somebody will remember it who has been around for a while.

AT: Yeah.

VV: That's interesting

GM: Do you guys; are you in touch with Darcie at all?

[Chorus of yes's]

GM: Speak with her she might remember something. And maybe it still exists. I don't know.

MC: What topics do you believe like that weren't sort of mentioned in the description do you think the museum could cover that would make it more beneficial for your class.

GM: Well specifically for my class it would be awesome if there was something more on fossils and maybe showing habitats, particularly for Nantucket. Like if we can't go out and explore, ourselves, the habitats maybe we will be able to see what would be in a habitat on Nantucket. The solids liquids and gases if there were some simple experiments that could be done, I mean, maybe those. I can't think of what else

MC: O.K Right now many of they exhibits are static and since they are taxidermy. They just stay there so you can't really go and you can't touch them or anything. One part of our project is to go and make them more interactive. What so you think is the best way to make an exhibit interactive for second graders?

GM: Well, like your saying its not something that they can touch right now and being able to touch whatever it is, is huge in, you know, the primary grades. So that would be one really big piece if they could touch whatever it is. Like if, you know, could have something on gears, like I don't know at the Children's Museum in Boston, the Science Museum, you know the place, and I don't know if they still have it, I haven't been there is a while, but they have the gears where you can actually, it's a big wall and they

VV: They still have it.

GM: O.K.

VV: We went to visit and we spent way too much time at the gears.

[Laughing]

GM: Yeah, so something like that, you know, I don't think it would be that complicated to set up something like that where they can move gears.

VV: Yeah

MC: So they can see how it works, sort of that way.

GM: So something like that or the fossil idea having them uncover something in sand or something like that, cus you could have just a small table. I mean you guys are limited on space so.

VV: Yeah

GM: You have to…

MC: Some of the people at the MMA have talked about bringing in like videos and stuff like that. Do you think that's something that would be good or that their attention span is more like moving picture and then sort of moving on to something else.

GM: I'm not a big fan of T.V. so don't think I'm a good person to ask about them. I'd rather just have them touching or making or observing and that kind of stuff. They get plenty of T.V. at home so. And I'm sure that there is some benefit to it.

[GM asks about how we got here, chose the project site and talked about stroll.]

MC: Do you have any more questions based on the exhibits?
VV: Nothing based on the exhibits.

MC: You said you went on a field trip to the MMA like nine of ten years ago. Out of curiosity why did you stop?

GM: I think it was a school, it was something that they were, you were invited there and that was kind of it.

AT: And you haven't pursued it on your own?

GM: No

AT: Just...

[coughing]

GM: Other things came up or the relationship and that specific piece hadn't really been developed further, but this is going back like nine or ten years so.

[Principal John D. Miller interrupts shortly and asks about our stay on the island]

MC: Are there any obstacles that would keep you from going on to a trip to the MMA if they had programs that were good for your class?

GM: Financially, if there are cost to the school to go there, that would be one obstacle. And transportation would be another obstacle and that it right now.

MC: Since you have the Massachusetts Frameworks and everything, is that a big thing that helps you decide what field trips to go on?

GM: Yes

MC: So if they met a lot of the frameworks then you would be more willing to go on field trips?

GM: Yes, absolutely. As long as we had support of the school system and the Maria Mitchell then it'd be fine. It'd be great.

Appendix C-11: Kara Carlson and Janet Brannigan Transcription

Note: November 17, 2008 3:00pm (20:48 minutes)
Molly: Updating the exhibits in the Maria Mitchell Hinchman House, which are the natural science exhibits. We're conducting interviews with you and other teachers to sort of get a feel of what you think needs to be included in the museum, what they can do to encourage you to take field trips there.

Victoria: So, you teach fifth grade, right?

Janet: Yes.

Victoria: What do you like about the fifth grade curriculum?

Janet: Well, I think it's really interesting. It's good for the kids. For history it gives an awful lot of our American history and its beginnings.

Kara: Are you asking about science?

Victoria: Mostly science.

Janet: Or math? They build on what they learned in the past.

Molly: What science topics do you teach in your classes?

Janet: We teach adaptations. We teach water and weather.

Kara: Simple machines, which is a part of science/technology/engineering, physical science. Oh we have, I have it right here.

Janet: Landforms, erosion, weathering.

Kara: This is our curriculum, the fifth The Massachusetts science frameworks which you probably know is three to five. So we have broken it up. We've assigned different standards to third grade, fourth grade, and fifth grade so this is what we ended up with. Earth's history and soil, weather, do you have a copy of this? We can give you a copy of this. Or you have it already. You already have the frameworks for grades.

Victoria: We do have the frameworks.

Kara: Yeah, plants and animals, the behaviors, growing towards the light. We have states of matter, forms of energy.

Janet: We have two technology and engineering standards.

Molly: OK, have you ever brought your classes on a field trip to the Hinchman House?

Janet: I don't think I ever have.

Kara: No, I've been myself but no.

Molly: Have you ever had any class involvement with the Maria Mitchell Association at all?

Janet: Oh, I have. They've come, they've come to us. They've done presentations here and I've taken classes there in the facility itself and out on the field. We've gone.

Kara: I did a vernal pools unit and Darcie met us out there and Emily Molden (Resource Ecologist) from the Land Council met us.

Janet: And order and weathering did a lot of the weather and water. We did a lot of connection through Darcie.

Molly: Have you been to the Hinchman House personally?

Kara: I have been. I took my nieces there last summer.

Molly: As the exhibits are currently, do you think they're good, that the museum is a good place to take your class?

Kara: For a whole class at once it's kind of small and tight for a whole class. But it was great when I had just three girls with me and what was really great in the summer were the young interns, those college-age interns. They were just so excited about what they were studying: the spider or the different animals and the exhibits and those young people explaining to the kids. The one-on-one attention was really good.

Molly: I just had a question that ran away. One thing we've noticed as we've been studying the Hinchman House is that the exhibits seem to be more identification based. Do you think that's something that's good for your kids or do you think it needs to include more hands-on type of exhibits?

Janet: Hands-on.

Kara: Definitely hands-on, yeah.

Victoria: Yeah, we were looking at it and we noticed that a lot of it doesn't really focus on why things happen. It's just, it's kind of… this is a bird, this is its name.

Kara: Uh-huh, right.

Victoria: So we were thinking of maybe incorporating more of why is this important. For example, with the evolution of skulls, bird skulls that they have, just thinking of why that has happened as opposed to just showing it.

Kara: Or adaptations. What adaptations does this bird have?

Victoria: Right. We're building a prototype about that actually.

Janet: Yeah, and that would be something that would fit in beautifully with our curriculum and more of a reason to go.

Kara: And every animal, all the—whatever they do, they burrow the earth and lay the eggs, and the beetle that they—

Victoria: Burying beetle.

Janet: I can't remember exactly when it was but I know I brought a class there or we had stopped there for some reason and we were looking at all the animals in all their cages in the aquarium section in the back and I think it was Darcie, I'm not sure, who directed the kids to take a look and then draw a picture of and get the details so that they were actually sketching the animals. When did I do that? Last year or the year before?

Kara: I don't know. I've never been to the Hinchman House with kids. We took a class there together.

Janet: I can't remember.

Molly: Do you believe there are any topics that are covered well in the Hinchman House from what you can remember? The have a bird room, a general ecology room, sort of like a marine room, and then a live—

Kara: Yeah I think the birds, they were a lot of things. They have a lot of things I think you could jump off of and do more in depth. Aren't there shells, too, and—

Alex: Yes, there's a couple shell displays.

Molly: Yes.

Kara: Yeah, yeah, I think you have to make them more exciting, you know more interesting or…

Victoria: Are there any topics presented in the museum that jump out at you, that you really think should be more prominent or anything like that?

Kara: I don't know. The things that– I remember going in that first room on the right with the cages with the terrariums and that was… I think that was the most interesting part.

Janet: Yeah it was. I don't know. I'd love to see that first room, that big like the classroom room you know with the big gift shop and everything. I'd like to see more in there of interest for the kids. I know it's—you know, to draw them in. It would be great if kids could go in there and take classes, just now our classes are seventeen and eighteen. Last year they were topping twenty or twenty-two but it would be great to have enough room to fit everyone and then let them do some hands-on.

Kara: Get the teacher who's an expert in whatever it is they're doing.

Molly: Would you be interested in taking your classes to the Natural Science Museum if they had a tour of the museum and they had more interactive exhibits there and then…

Kara: And something that matched a frameworks standard.

Molly: Right, and then also had activities in that main room to further—

Kara: A lesson to do.

Molly: Right.

Kara: Definitely. That would really be worth our while.

Janet: Something that's going to activate their knowledge and give then them the little tease and then have them really jump into it.

Molly: Are there any things that are preventing you from taking your classes to the Natural Science Museum, reasons why you don't look at it as a place to leave the classroom and take them to?

Kara: Maybe the size of it.

Janet: The size and, you know, just finding exactly what's going to fit our frameworks.

Alex: So, fitting it into the curriculum?

Janet: Yeah, which we have to do. We don't have time to take a trip just for the sake of taking a trip.

Kara: If they said, "Hey we have this great lesson that matches this on your fifth grade frameworks and we'll take care of teaching that lesson, that standard," we could definitely run down there.

Janet: I took the wildlife and aquatic quest, Project Wild there, which a good portion of that, I can bring into the classroom. We could talk about it and do the games and some of the activities. That gets the kids very excited. But it's OK we're going to do adaptations right now and this lesson works well for it and this game. Then it's over and done. It'd be great to have more but we need to keep moving through the curriculum, too.

Molly: That's most of our questions.

Alex: Any questions that we might be able to answer for you?

Victoria: Any clarification of what we're doing?

Kara: Well, how long are you here?

Victoria: Until the 18th of December so not very long.

Kara: Are you having a semester abroad?

Alex: It's a term.

Molly: So yeah.

Victoria: At WPI, we have four terms so seven weeks of being here and working on this project intensely and then, yeah.

[TALKING ABOUT WHERE WE'RE STAYING, MAJORS, ETC.]

Kara: Are you mixing with children at all? Are you doing any work with children?

Molly and Alex: Yes.

Alex: Tomorrow we're having a group come in and test our prototypes of exhibits.

Molly: The Lighthouse School is coming and bringing, I think, most of their kids through the museum since we have prototypes built. Would you be interested in having your class come for a visit?

Kara: We could.

Janet: Yes, but it depends on when it is and—

Molly: After Thanksgiving and everything. It'd be sometime in December.
Kara: Yeah, I could come. Email me when you're ready for us and we could walk down there. Do you want all nineteen kids at once?

Alex: Sure.

Kara: Do you want to try it with a lot at once?

Alex: Tomorrow we have some fifty kids.

Kara: Fifty kids at once?

Molly, Alex, and Victoria: Not at once.

Victoria: The biggest wave is twenty-three.

Kara: Then will the kids rate it or score to give you feedback.

Molly: Yes.

Victoria: We're thinking of making little investigation packets where the kids will go through and there will be little questions like "Why do you think this adaptation is important?" The exhibits that we're going to be making will be hands-on anyway but after they do that they could be able to answer this question, "Well it would be because of this lesson I learned."

Janet: That looks good.

Victoria: And hopefully that will be a way to trick them into answering our survey questions to see how useful it was to them.

Kara: They could also tell you whether it was interesting or boring. Did I learn from this?

Victoria: Exactly.

Janet: That's good!

Kara: Another way to go about it is "Would you recommend this for another friend in fifth grade?"

Victoria: That would be a good one.

Molly: We have consent forms that our school gave us that the parents have to sign since we will be observing them to see how they interact with our prototypes and if they like them or not.

Alex: So if you would like to come, could you please distribute those to the parents?
Kara and Janet: Yep.

Victoria: Unfortunately it's a lot of legalese.

Molly: It's because we're dealing with children. They want us to go through this. If your class came, one of the staff members would give them a tour of the museum and explain things that way.

Kara: Like Darcie or Marjie?

Molly: Cheryl. They'd be able to go through the museum, see the exhibits, and interact with our prototypes. That's where we'd observe them. We just tally seeing what type of interaction they do with them. Then they have the little booklet so they could learn and ask questions about, not just prototype questions but other exhibits in the museum, too.

Kara: What are your prototypes? What are the topics in the prototypes?

Victoria: One of them is bird adaptations and a second one is mostly for younger grades but it'd be nice to have little bit of older input, too. It's a storybook about erosion.

Kara: We have erosion. We have landforms and erosion. It's important.

Victoria: So those are the two that we have right now.

Kara: Are you going to have any more by the time we go?

Victoria: We might. We're looking into maybe the changing shoreline of the island. We're talking to GIS people who make maps. We're looking into the most recent maps and some older ones so that we could possibly have transparencies and have different colors showing the different types of shorelines there were.

Janet: 'Cause last year we went out and we—or was the year before and we measured the erosion.

Kara: At Sankaty Head with that tool where you line up to the horizon. I don't know what that tool was with Sarah Oktay (Managing Director of the UMass Boston Nantucket Field Station)

[TALKING ABOUT WHERE TO GET TRANSPARENCIES/OFFICE SUPPLIES.]

Janet: How long would it take? How long would you expect the kids to stay there so that parents could know we could leave at what time and then come back at what time?

Victoria: We were thinking roughly an hour because the tour shouldn't be more than fifteen/twenty minutes. It is a smaller place. Giving them time to actually look through everything should take maybe twenty minutes on answering questions and then the end survey of did you like this? Would you recommend it to a friend? That shouldn't take too long.

Alex: That’s what we’ve allotted for tomorrow. If it’s completely off and we need more time we’ll certainly let you know via email.

Kara: Just let us know.

Victoria: Mike Girvin’s class is also going. They’re going Thursday. We spoke to them last week.

Janet: Great. Sounds good.

Kara: Did you talk to his whole class?

Alex: No, we just spoke to him.

Victoria: He was very excited.

Molly: It’s our hope to get as many groups to come through because each time a group comes through, we’re going to be changing them, modifying the prototypes, trying to work on the language, if certain things don’t work well or they can’t understand how something works then we’ll try to change that before the next group comes in and retest them

Kara: Would you want the other two fifth grades? There are five fifth grade classes. Would you want the other two if they want to come? Or is three plenty?

Victoria: We think three is plenty since they’re all the same grade.

Janet: The erosion book, you said that’s kind of primary, easy?

Molly and Victoria: Yeah.

Janet: Could you think about making that a little more advanced?

Victoria: We could. Yeah. We have a very large spectrum of ages that we’re looking at.

Kara: They do even two/three year olds, don’t they?

Victoria: Yeah, our sponsor wants to change if from normally the kids who come in are maybe three or four and she wants to raise it so that it’s K through 6 so it’s a very large window. The adaptation one would probably be the most interesting to fifth-graders.

Kara: Which age is the erosion one geared to?

Alex: Well, we were thinking of doing a story book kind of thing, a child book with one sentence a page. That’s why we thought it would be geared to smaller kids because fifth-graders would flip through it really fast. The idea is still the same. It would still get the concept of erosion out there just in a much more interesting way and it would be feasible for the younger kids that we know will show up.

Janet: Do you do anything with time and geographical changes of the island, like the glaciers from that period forming?

Molly: Not yet. We’re going to make recommendations on the museum to include a better exhibit on how the island formed but with the time that we spent on the island, we can’t come up with a good prototype that works really well in this short span that we have. We should be able to have a working model that we could test.

Alex: I think a good way of representing it would be something digital, a CG of an iceberg coming in and then receding. That would be a lot more visual.

Kara: Then the kids would understand that it’s a mile.

Alex: It’s hard to even imagine, so having some sort of CG thing—

Kara: Showing how big a man is.

Alex: That would be really hard to make a prototype for and be able to test. We’re just going to include that as a recommendation.

Janet: Were you with me when we did the erosion one with the frozen ice and the sand and we pushed that ice and then watched it melt and watched waterways? That was nice hands-on.

Kara: Yeah.

Alex: Cool.

Victoria: Well, we’re working to make the museum more hands on. Even though the trips outside the museum are really nice, it seems like a lot of teachers feel like that’s the only option just because right now they are.

Alex: Any other questions?

Janet: No.

Victoria: Thank you both for your time and your ideas.

Kara and Janet: You’re welcome.

Appendix C-12: Marjorie Thomas Interview Transcription

Note: MC - Molly Congdon
VV - Victoria Valencia
MT - Marjorie Thomas

MC:
So we pretty much just wanted to what your opinion of the current museum are, you know?

MT:
O.K.

MC:
Like how effective it is.

MT:
Um, I know right now they are doing personal tours during the summer. And I think based on that its good information for the regular that we usually have like a mom and dad come through with their couple of kids. And I think it's good because the parents think its good because they learn all this new stuff. But I'm thinking that the only thing that draws the kids in is the animal room. That I guess being said is I think its is good for more adults that way, its set up so that the adults learn a lot and the kids get to go see animals, so they are excited that they got to see animals. And I think it could be more educational for kids, And I think, if we, I don't know what direction the museum is planning on going right now or where they are or who their focus is, but I would think that since most parent come not for themselves, they aren't trying to get, if they want to go to a science museum they would go to somewhere like Boston. If they want to go to a Natural Science museum to learn something probably not your local museum here, but they come because they want their kids to learn stuff and have an activity to do. And that being said I think that should be of a children's museum cus, since that is our focus and that's what our main focus is with education is we are doing elementary school kids. Uh so they need to be more hands on approach for uh the museum the displays can have just words they need to have things that kids can try to do so and bigger themes that can be applied to several different things, animals like the idea of an animal having adaptations that are tools uh that we have tools that are like. Or uh an experient, a big thing with young children is putting them in the position of an animal so that they see what the animal see or they uh experience what the animal experiences. And so they have to understand that maybe a bear is not bad because it, a wolf is not bad because it's trying to eat little pigs, wolf needs food, the wolf you know, its not one thing is bad one thing is good, this isn't scary this is something that is the way the animal lives. And the same thing with uh the same thing that they need to understand how thing affect their lives. I think is a major thing that is too disconnected for them, for such young children, they have trouble, a hard time seeing the bigger picture. Sorry I rambled on.

VV:
No that was good we can get a lot of quotes from that.

MC:
Um one thing some of the staff members have expressed interest in is keeping the museum like it is now sort of a museum of a museum like this is how the old natural history museums were presented and wanting to preserve that feel since everything is becoming more modern and technology based. Others, have like you said before, have wanted to lets build tunnels all over the place and make it completely new and cool.

MT:
I think there is something good in preserving something that is old what is good. Don't fix something that's not broken. But I think, I think there is more research being done today on what is good educational practice. And representing an educational place I don't think we should stick with all these old, I mean there is some good that comes from old displays, but I think that it's really pretty boring. I mean I know that sounds horrible. It is really boring. There is nothing that I want to go look at down there. Add I am, you know, supposedly becoming a young adult coming through, but I can't imagine a child wanting to go look at the dead birds; like yay lets go look at dead birds. It's like a still zoo, which is not what it's supposed to be. And, I think it is a lazy approach to not evolve continually and to tweak yourself or your, your exhibits to best educate the people. I mean obviously it's not doing its job right now and that means something is wrong with it. It might be cutesy and it might be quaint to keep it an old natural science museum but it's not doing its job. And that's how I feel.

VV:
How do you feel about the age group that they are attracting, cus you mentioned adults dragging their kids?

MT:
Yeah.

VV:
In an ideal museum what kinds of kids would you want in here?

MT:
Uh, all kinds of kids you want in a natural science museum. I, I, we do, I mean if you look even at our wait lists and our educational programs that we have. We have programs that go through 12. We have, if you go through and look at our records for who we've had sign up, in March or April. As soon as our registration starts opening up for the 4-6 yr old age group it's filled. I mean maybe with the exception of the first couple of weeks people aren't planning on being on the island yet. Those might not be filled until the week of then they'll be filled. But the 7-8 we get kids in there, but we are just filing it. We don't have anyone waiting. And when you look at the 9-12, we don't have any. I mean we are getting maybe 3 or 4 kids and that's it. Which I mean, then we've changed our program. To O.K. do you really want to focus on 3 or 4 kids? So the point is as they are getting older, they are getting less interested and I think that is because there is more stuff to do for older kids on the island. I think that it is good that we are focusing on the young kids cus then you are getting them interested in it early, but I think and I mean that, you have to start somewhere. I think that broadening it and by making it a larger focus is a bad idea when you are trying to start a new project you need to stay focused on that one group. And then if you are getting strong in that, then you can maybe build on the on the next group. You could maybe have something for the older kids, but I think focusing on the younger kids is good for right now, until, I mean we are having money problems here. We are having, you know, we need to secure the younger kids before we start moving on to older kids. I think when it comes to the museum, because the truth of the matter is that we are getting the younger kids that is, who our clientele is. We need to secure that and make more of that before we start moving on to focusing on other kids at the moment; if that makes any sense.

VV & MC:
That makes perfect sense.

MT:
Which is part of the problem with the organ association right now is we're spreading our self way too thin. And we are not sticking with one program before we try to start a new program. And it cost just way

too much money and we are going in the hole. And I feel that if you stretch you self way to thin pretty so you are going to crumble and you aren't going to be able to keep anything open so….

VV:
Anything else?

MC:
No, nothing.

MT:
Well I hoped that help you some.

Appendix C-13: Mike Girvin and Matt Liddle Interview Transcription

Note: MC- Molly Congdon
AT - Alex Tutone
VV - Victoria Valencia
MG - Mike Girvin
ML - Matt Liddle

[recording starts mid-sentence of Mike Girvin talking:]…Doing something, you said, in conjunction with Maria Mitchell.?
VV: Yes, um, it's basically, we have a project @ WPI called the Interactive Qualifying Project…
MG: Yep.
VV: …and it's basically outside your major, you do something…
MG: Ok.
VV: …and it just needs to be a very major project, it counts as like a third of your course load…
MG: Oh nice.
VV: …or something huge.
MG: Sounds like this is something really important.
VV: Yeah but it's basically so we're well rounded people and not just…
MG: Exactly!
VV: …Metal heads…
MG: Not just the…right, I got ya. We have actually Jane Hobsendepon's(sic) son, she teaches computers here, went to Worcester Poly…
VV: Awesome, really.
MG: …just graduated, Max Hobsondepon(sic)? I don't know if you know him, I'm not sure how big this school is but…
VV: A couple though, well maybe a thousand and some change…
MG: Right.
VV: …So not huge but
MG: So these are like grad requirements to try and broaden your horizons as…
VV: Yes.
MG: Opposed to coming out just…
AT: As just engineers.
MG: Gotcha, *just* engineers. Ok, alright so, 5th grade science.
VV: Yep.
MG: I guess that what we start with here, er well, different teachers, there's five different sections of 5th grade at the elementary school, there's about 87 kids…
VV: Oh wow.
MG: In the 5th grade, about the average size class, um, so we have around 17 to 18 kids per classroom, um, different teachers can start with different things, different subjects, based on, you know, how they wana tie them together, if they tie them together, or just, I think, area of comfort, um, I start with land forms, um, which we do through September and October, and basically the effects of erosion and weathering on, um, land forms of the earth and I guess what we've looked at are, um, we do all kinds of different things, we use, we built a stream table, this wooden thing in the back it simulates erosion models, has a little pump in the bottom, and kids learn about, um, you know, just the effects of erosion, and we do some field trips on the island, because there's so many different…
VV: So you do field trips.

MG: We do, I haven't done an erosion or a land form field trip this year, um, we've done other things, that were sort of mini lessons in science that came along through the Nantucket Land Council like the Monarch Butterfly tagging, that we did through the University of Kansas, are you familiar with that?
VV: No.
MG: It's kind of a neat thing were you go out and you actually capture Monarchs in the last part of their time here and tag them and then it's, the hope is that these tagged Monarchs will fly back to Mexico, to their point of origin, but by this point they're sort of great grandparents of the ones that started out the journey, it's kind of an interesting science but sort of ties in land, life cycles which is what we, sort of an ongoing theme through the elementary school, they start with Monarch butterflies and um, frogs and whatnot, that they study from kindergarten on, um but, in order to, so that, I guess that, the steam table we built two years ago, that mountain right there is a, shows the contour, it's a contour kind of concept 'cause they we finish up with contour maps and different elevations and such and its interactive [walks away from recorder and becomes incoherent or a brief amount of time] it lights up different points, um, and different land forms [briefly talks to his daughter] but anyways, the last year's class was sort of a group of barbarians that ate this thing alive and broke everything up but I mean like the base, you know, the bottom of a mountain, um, that one still has to be re-soldered, a valley is a low area of land through which a river flows, which is down there, and so on, there's a V-shaped valley eroded by a river is also known as a canyon. The kids all wired these a couple years ago and so I used them afterwards for, you know just for…
VV: So the kids built this?
MG: The kids did, yeah, I was a carpenter before I was a teacher, so I helped them with the power tools and stuff but they did this, and then they did this as well, kids fiber glassed the inside of this, then they ma-, this is kinda, after a while we just sort of have fun with it but we get into showing meanters, um, and dams and levees and the effects of those and it drains down into here then pumps back up through here, and they can plug different holes in this, depending on where they want the water to come out, um, and that's kind of a neat thing at 5th grade, you know to just get an ongoing river running in the classroom, um, we went out and saw Sankaty Lighthouse being moved last fall and which was very cool, and saw all the heavy equipment and engineering that went in on it; I don't know what kind of engineering you guys do, but, um…
MC: I'm not an engineer.
VV: She's a chemist.
MG: You're not, you're what, you're a chemist?
MC: I'm a chemist.
MG: Oh god, you guys are way above me, so, we do, we do some chemistry too, little bit, you know, not too heavy duty, you know, lot of vinegar, lot of baking soda, um…[addresses his daughter's cries for attention]…we move on to weather, and um, because weathering and the whole effects-
[Enter Matt Liddle with his daughter]
ML: Hey what's up?
MG: Hey, this is Matt Liddle, have you met these guys before?
AT: Hello.
ML: Hello you guys. Nope.
[Mike brings Matt's daughter to the attention of his daughter]
MG: So we do the, and then we move from erosion and weathering and get into the effects of weather and then how weather's created and last year I got a grant from the Land Council here, and we installed those, um, maximum weather instruments in the front lobby of the school, there's an anemometer, a barometer, and thermometer…
AT: Sweet.
MG: The kids learn from it, weathers kind of difficult to teach at this level just it's so abstract in a sense, but they learned about the water cycle, and they do that in previous grades so they build on that and the weather…

ML: Hey Mike.
MG: Hey, I’ve got my curriculum mapped out here, uh, life science, this is actually pretty cool, we get into, plant and plant behaviors, you know, um, geotropism and phototropism, and then tomorrow, um, we have a guest reader, a friend of mine, who’s going to read about, um, the hanging flowers in Mexico that don’t root in soil, what are they called, they start with a “G”, I can’t remember, I’m sorry, but anyways, he’s guna come in and do that, but we talk about adaptations, plant adaptations, animal adaptations, um; am I doing all right with this?
[Medley of agreements from MMA team]
Just sort of topic by topic, I mean we can go into all kinds of depth, you know physical science, we do, um, compare and contrasting, um, states of matter, solids, liquids, and gases, um, and how heat effects those, we get into saturation, and concentration, I know you’re- she’s a chemistry major so she’s like oh boy that’s pretty exciting; we’re on tape right now too by the way so no [mumble]…
AT: Is that a problem?
No, it’s fine, um…
ML: Just no pictures.
MG: Various forms of energy we move into after that, um, I’ve got my, we do alternative forms of energy, I’d love to get the kids out on a boat this winter at some point to go and look at that observation tower, we could do that together [addressing Matt], out in the middle of the sound, with regards to Cape Wind, we do debates on that, ‘cause that’s huge and we’ve got two Democratic senators who, on each side of the sound that keep track about renewable energy and they, both of them oppose the wind farm because they don’t want it to ruin their view, cracks me up, Mr. Gary(sic) and Mr. Himity(sic), um, and we talk about how the transfer of energy from, um, like Niagara Falls how a generator turns the turbines, that goes and goes and goes, and creates electricity, um, life science, same thing we do plants and plant behavior, um, and where they fit into food chains, um, and then in technology, we do, er, you know engineering stuff, we do simple machines, um, we go up and we visit the old windmill here on the island, I've got a block and tackle up here to talk and learn about mechanical advantage, I’ve got another around here, a deer hoist, it’s up in that rafter up there, just kinda leaning over those pipes, um, and they learn about inclined planes, um, leavers, axis, and wheels all that, and what else do we do with regards to that, um, I think that that’s kinda quick, really quick overview of the 5th grade science, um, part of the plant stuff that we do, we talk about secession in a forest, you know, after a burn, how the plants will come back but how it effects population too in the animals, where it’s a field trip, and then we get into everything from producers, consumers, decomposers, and all that stuff, um, field trips, what are the fieldtrips we do for that, we go out to see the kettle ponds in the middle of the island, which are just the non-fed, there’s no incoming or out flowing stream and they look at all the different sort of flora fauna around those and explore that and, I’m thinking, that’s about it. Was that too fast? Too vague? Is it all right, can you work with it? Alright.
VV: No.
ML: So what’re you doing?
MG: What am I doing?
ML: Just kinda running through your…
MG: They’re doing a, this is a grad requirement for their degrees up at Worcester Poly Tech…
ML: Well I figured I’d let them tell me what they’re doing.
MG: Oh well alright. So I’m just going through the 5th grade science curriculum, we can get into math too if you wana get into that next or later, that’s up to you. Now the New School, the alternative school.
ML: So why don’t you guys introduce yourselves so I…
VV: Ok.
MC: I’m Molly.
ML: Molly Congdon
VV: I’m Victoria.
ML: Victoria.

AT: I'm Alex.
ML: Oh I forgot, we don't want anyone listening to those, um, and so, a little bit of what Darcie told me is you guys are going to be working at the Hinchman House?
VV: Yes we are.
ML: Working on the exhibits?
VV: Yes.
ML: Cool.
AT: Trying to build prototypes, we're going to build prototypes to, prototype exhibits to better, um, display some of the ideas that some of the current exhibits don't quite get across.
MG: Nice.
VV: Which is why we think it's amazing that you guys have all this stuff going on here.
AT: I can't believe you guys have such sophisticated things…
VV: I wish I came here for 5th grade, I didn't have any of this.
MG: That's an interactive map there too, the early explorers, but that's social studies, you don't want to go there…
VV: Still interactive, still very cool.
MG: Push buttons…
VV: We just had textbooks.
AT: Your schoolroom is more interactive than the museum.
VV: It's true.
ML: Yeah the Hinchman House, yeah, that museum, yeah, it could use a little more Bang, pow, wow.
MG: And it's such a cool opportunity down there, I mean it could be so great.
ML: I mean the birds are way cool but…
VV: There are too many of them for you to absorb them.
MG: That's exactly right, it's a little too over stimulating.
ML: So is it helpful then to go through kind of what we teach to science?
VV: Yes, because it will give us ideas about what we could pull out and, um, I mean like if you tell us 'this is something that we spend a long time on', then we might be able to say 'wow if we can do an exhibit on that, that would reach a lot of children…
MG: Right.
VV: …and they would be able to bring it back, and that'd be cool.
ML: Well I'll tell you, I wish we had, uh, there's another young lady that teaches science at the New School with me, I wish I had her, we do maps as well, her curriculum, but I wrote one of the courses she teaches so I can speak to 6th grade and 5th grade is a lot of Life Science, but what I do at the New School for 7th and 8th grade, this is just what I do, for the 7th and 8th grade is and earth science course, loosely based on the state frameworks [Asks Mike a question regarding his daughter] it's loosely based on the state frameworks, which I was at the high school here for a number of years and had taught oceanography there. What it is, is an oceanography course based on the state frameworks of a full year science course, I touch upon what, you know, the Department of Ed. deemed important the concepts and topics to hit in a full year course. It's not a one year course though, I spread it out over 7th and 8th grade because it is a lot of material for that level. We start off in 7th grade with the origin of the earth and the oceans, um, again, I think of the Hinchman House as almost more Natural Science [everyone else agrees], like I was thinking of, and I'll get to it in a bit, but um, there's a great model in there that I want the kids to take a look at, the island?, the model of the island?, is that still in there?
VV: Yes it is.
ML: It's made from the maps?
VV: Yeah, apparently it was a 6th grade project from the '70s, er, from the '60s.
ML: Right, well we just got done doing what Mike did there with the kinda levels using contour maps but, I use bathometric maps, so instead of mountains, I do seafloors. So we're guna do like the seafloor, all the shoals around the west end of the island, and I'll get that, that's actually the second year, but, start off

with the origin of the earth and the oceans, um, from there we go into plate tectonics and seafloor topography, we do a lot with, um, talking about Pangaea and shifting plates, um, movement of continents, and again instead of the classic talk about, you know, India cramming in and building the Himalayas, we talk about the Mariana Trench and subduction zones and deep sea trench formations and instead of the Rift Valley in Africa which is pretty much mainstay, in our science course we go to the Mid-Ocean Ridge and talk about the spreading plates there and the rift valley forming there, um, I then get into the atmosphere but it's atmospheric oceanography, I bring in the currents, so we contrast heat absorption over land and sea, and unequal heating of the earth, everything is very much hands on, I don't use a textbook either, I don't think you do, do you?
MG: Personally I don't, no.
ML: No, we just use, I just use all of the local resources I can, get the kids out in the field, but atmospheric oceanography yes, so we get into modeling water masses, modeling air mass formations, we get into winds and wind's effect on ocean currents and we map the various ocean currents, and then the last topic of the first year is climate change, and changes in sea level. So we then go from massive atmospheric oceanography into, you know, El Niño, global warming, we spend quite a bit of time on global warming and changes in sea level, and that is when I sneak in tides and different tide things, you know very physical. "Mapping Our World", first topic of the following year, when we get into 8th grade, um, I do a cartography unit: "Mapping Our World". Start with how early maps were made, different types of projections and where they work and where they fall short, um, we watch "World's Deadliest Catch" and we track crab boats up in Alaska and, um, we actually do an activity on ship wrecks, and we go to Ship Wreck Museum for that, which is down by the Coast Guard Station, we do topographic maps to introduce bathometric maps, and that's where, you know, this is what we were just doing now.
MG: What the heck is a bathometric map? Oh from the bottom.
ML: Yeah it's like a contour map of the sea floor.
MG: You stay above the water?
ML: Yeah we, we're all in the water.
MG: Your fifth graders can't swim?
ML: And we wrap it up with, um, oceanography from space, electromagnetic spectrum and different satellites and how they operate, how they map the sea floor. Uh, next unit of 8th grade would be coastal land forms and erosion, um, pretty obvious we get out on the field a lot for that one, we work a lot with U-Mass Field Station, we do beach profiling, um, when it comes to erosion, we do, we talk about different methods of erosion, how they work, how they don't work, we get out and plant beach grass with the land council, um, next unit's wetlands and wetland protection, and we focus a lot on natural water sheds, working again closely with the U-Mass Field Station, um, take trips out to all the numerous salt marshes and we have a swamp here so we compare marshes and swamps, and uh, flora and fauna found in both of those and we get a lot into conservation and protection we talk about point, not-point sources of pollution, um, how wetlands work as a buffer so for a harbor, uh, land council granted us a great lamot(sic), you know, um, marine water test kits so we get out and test water, and right now, in fact, Sustainable Nantucket, and this is the beauty of my school, they came to us and said, uh, we have seventy-five, you know, home tap water test kits we're trying to get the point across that Nantucket's tap water's fine and if you want to cut back on landfill space and plastics then, maybe you can do a project with this, so I, we just happened to be on this, you know, point, non-point sources of pollution and coastal management with regards to nitrogen loading, and that nutrients, excess nutrients in the harbor and effects on ground water, we talk about ground water pollution, we talk about what's happening on Cape Cod with the military reservation, so when they came to me with that, I kind of just closed up the book, and said this is great, so the next two or three weeks the kids are working on that project, they developed a map of the island and broke it up into five regions or zones, and we got the school directory and we've got ten family in each zone, we're going to give kits, the kids have typed up an introductory letter, they've typed up a data sheet that's going to go with it, and they're actually going to present to the school community tomorrow morning, 'cause we have what's called "Morning Meeting" at our school, it's much smaller, so all the

grades get together in the morning and meet for fifteen, twenty minutes and we have a speaker. Verne was in today talking about birds.
MG: I said I'll have Freddy in tomorrow to talk about flowers and living in Mexico.
ML: It's a great island like that getting people in. Everyone's so willing to help out around here. We'll talk and address that; get the test kits and collect the data. Then they're going to again compile all the data. We're actually hoping the final step of the of it will be to present to Sustainable Nantucket and to present to Stop and Shop because going to try to get them splurge or a reverse osmosis machine, which they have at some of their shops on the mainland. It's like a Coke machine but you throw a buck in, you bring your own bottle and fills it up with water. After wetlands and wetland protection, we get into groundwater and groundwater conservation, which I've already kind of addressed. We take them out to Water Com, the water company, that uses piezometers and tests the depths of the groundwater, the water table and how that changes throughout the year. We analyze data that comes from Wauwinet about water usage over the summer versus winter and recharge. So this is a fun way to deal with the water cycle basically. Working backwards, sixth grade is also oceanography but much more life science too. We actually get into marine food webs. We start with tracking a whale from his birth in Baja up to the Arctic for the summer feeding grounds. We use that journey as a vehicle to introduce tertiary level currents and marine food webs. Wow, they're going up there to feed on the krill. We do biomass pyramids and things like that. Whales, we get into the different marine animals. Whales and cranberries, can't get enough of those out here. That's a common theme in a lot of classes. Fifth grade and sixth grade is almost all life science. Jo Slavitz teaches those guys.
MG: Oh, yeah?
ML: She's great. She's very curious about what you guys are doing because she is more in the life sciences and she couldn't make it today because she's got a couple young ones. So she is doing right now taxonomy, classification all based on Nantucket, animals we find on Nantucket. She takes the kids out into the field quite a bit. We have snorkeling equipment and we have aquaria in the labs. Kids collect specimens from the field. Even if we're studying wetlands or wetland protection, if I have them out in Consue Springs or Folger Marsh we'll be dealing with the importance of a wetland and its effects on pollution. I'll take them out for a couple of hours. We'll spend at least an hour just playing in the water collecting specimens for the tanks. So that's about what we're at. I don't know if that's helpful or not. Again, I can email you more specific stuff the kids map if that's helpful.
VV: You mentioned this Jo person who teaches fifth grade.
ML: Fifth and sixth.
VV: Fifth and sixth? Ok.
ML: Jo Slavitz. It's actually
VV: You mentioned that she's doing taxonomy and classification and things like that. Do you think that would be helpful to us?
MC: Yeah.
VV: She could tell us exactly why the stuff that we're looking at is stuffy and old because I don't know much about taxonomy and it doesn't interest me. Knowing someone who's interested and having her say it's not good, that'd be amazing.
ML: Yeah, I think she would be a useful person for you guys to talk to. I'll put her in touch with you guys if that's what you want.
VV: Thank you. That would be very helpful.
MC: Very helpful.
VV: You guys do a lot. I wish I grew up on Nantucket. You do all this fun stuff.
AT: Yeah, really.
MG: It depends year to year, too. This year's class, they've got more done already. Last year's class was tougher. It was a lot different chemistry between kids.
AT: You guys are talking about stuff I don't even think I've ever learned and you're talking about it in sixth grade. It's crazy.

ML: Well, again, I don't have text books. I don't even give tests and I'm not really content and content-driven. By the time they're in college like you guys, they might look back and go, "Oh! I remember something about that. Really what I'm after is just to foster this interest in the world around them and the school I work at, the reading, writing, and language arts are of high priority so we also read a lot in my class. We just dot done reading Grayson, which is, I don't know if you have read that or heard of it. It's by Lynne Cox. It's about a young girl from Santa Barbara goes swimming, she's a long distance swimmer, and a baby whale swims next to her and lost its mom. It's a true story. She couldn't go back to the beach because the whale was going to strand itself. It's a whole story of this girl trying to see if she could find this its mother. There's a lot of marine science. They read Over the Sea by Hemingway. I read Kontiki, which is really cool so I believe that if we teach them to read well and to write well and be able to make it and to have a natural curiosity about the world around them, when they're your age professors can cram content into their heads. What we know about the adolescent brain it's not really worth my time or theirs to be just focusing on facts. Unfortunately, some of the public schools have no choice. It is content-driven because there are tests. So you say that some of the stuff you may not have had. I'd love it if they walked out of here knowing and remembering all the stuff we talked about but really it's a curriculum that I wrote to try to keep them outside on Nantucket as much as possible. We utilize the institutions and resources we have out here on the island as much as possible and to keep them having fun because there'll be plenty of time for them to learn all that other stuff. We'll keep them, "Oh, yeah. Cool, it's science!" and "Aw bummer, I thought we were doing science now. It's math." That's when you know you're being successful. That's the way it is. These kids, in this classroom especially, should all remember this classroom.
VV: Very nice
MG: It's fun. It has to be fun; because I'm part of it. If I'm not doing something that's not fun…
VV: Have either of you brought a class out to the Natural Science Museum, out to Hinchman to see what we have there?
MG: When I first started teaching here years ago, I had a group of kids and it was a small group of fourth graders and I did not take them to Hinchman House I took them to the old observatory up and across the road. We all worked on a light project that was extremely cool at the time with a guy that was affiliated, Michael Chaven used to work for Maria Mitchell, and we worked with refraction and reflection. It was really, really cool with lasers and bending light, breaking light. That was the only thing I think I'd ever done at Maria Mitchell. In all honesty, we've done a few outings with them. Last year Darcie took us out and we looked at the vernal pools. We did a little mini unit on vernal pools and went out to Swan Swamp where we classified them with the state and that was kind of cool. The microscopes and all the gear and looking for the ghost that the shrimp, it is the ghost shrimp, isn't it?
ML: Fairy shrimp.
MG: Fairy shrimp in the vernal pools. That was something we did with Maria Mitchell. I think prior to that we used to go to the library with small groups to break them out and work in a quiet, kind of interesting place.
ML: Yeah, we used to use the library years ago.
MG: We used to use the library years ago and walk down on a Friday morning at 9:00 with six kids that were studying something. We'd use the resources that were over there but we've never used Hinchman House. Never have. I don't think many people in the building have.
ML: I can't remember the last time. I think maybe we went over there for the spider exhibit or something that the kids went to last year actually.
MG: Oh, the tarantulas.
ML: I had a group. It was on an eighth grade trip when it was going.
AT: They have a new spider exhibit now. That's with black widows mostly.
MG: Right, it was the black widows and one that's indigenous to Tuckernuck. Yeah, that was the thing I remember reading about but never did anything with them.

ML: Yep, and then one of the guys took them out in the field. Again, I wasn't here so I can't remember his name. One of the young interns took them out in springtime. The interns were in so they took them out in the field, out to Miacomet to look spiders and aquatic insects.
AT: Was it Andrew?
ML: Yeah, I think it was Andrew actually. What's his last name?
VV: McKenna-Foster.
ML: Yeah, that's who it was and I didn't get a chance to meet him because—
VV: We never met him either. He's just a name that keeps coming up.
AT: He's apparently very active at the museum and we've heard of a lot of things he's either designed or suggested to implement.
ML: Yeah, we used Maria Mitchell more until they came up with the cost. The cost has changed now so that's a been a factor at my school, where we have very small budgets and that's unfortunate because I think it's $65 an hour they charge now but they'll give you two hours to $120.
MG: I know from the public school point of view, with the town budget being locked and the fact that they're going to start cutting jobs at the elementary school, middle and high school. They don't want to be spending other dollars on things like that. The Land Council, you call them up and they'll take you out. They're more accommodating. Maria Mitchell is so much to maintain. They have to make money to do what they're doing. They're campus is huge and the real estate's off the charts down here now. It's tough.
ML: The Land Council's great and the UMass Field Station, Dr. Sarah Oktay's out there. They are awesome at just supporting what we're teaching and giving kids another voice, another activity, another face to look at, which is important.
VV: Interesting.
MG: What else?
MC: If there wasn't the problem with the budget and all that being changed, would you actually be interested in taking the classes to Maria Mitchell and working with them more.
MG: Yeah, I think you get two totally different perspectives. The fact is that Matt, coming from the private school, has more time. He doesn't have to justify and have to tie it in as much as we do in the public schools now. I would go out more if I could but we're battling, always battling time and the curriculum, not to say that Matt's not doing the same but he has more opportunity. For instance, right now just talking about the Hinchman House and talking about adaptations, I mean you do bird beaks down there. We could do that. That's a field trip right there and I never think about doing it. That's something that's on my list. We have a new principal and actually the principal that was here thirteen years ago and he's pro doing all this stuff. Just sitting here and talking to you guys is starting to make me think, which is good. I would, I would certainly take advantage of it and I think that other teachers would but I think there's a fear. I could speak for the other four fifth grade teachers, I know that there's always that "Gotta go, gotta go, gotta go" We've had these broken up weeks and we always feel like the time is always working against us because we have this framework. If you feel that you're missing something then the parents are all jumping down your throat. This school is in trouble right now. We haven't met adequate yearly progress for our third year so we're on one of those warning zones where the state's not down taking us over but they're now putting a magnifying glass on us. I think a lot of it has to do with the fact that our curriculum has been lacking. We've been doing a lot of these maps. We've gotten so big and so diverse so quickly in the last ten years it's reeling. Kids from Central America, South America, there's language barriers. There are challenges here right now. I used to be the science coordinator in the school, which was K to 5 science for three years and on any given year I'd probably do sixty-five to seventy-five field trips for the whole school. That was just me, not even the classroom teachers. It's diminished.
ML: I would. I can. I'm not restrained like that. Again, it's the cost thing. We did the school membership so a dollar a student to go to the Hinchman House.
MC: Have you been to the Maria Mitchell Association just by yourselves as visitors in the Hinchman House?

MG: I've been a board member at the Maria Mitchell for the last two and half years and I just resigned last month. I've done a whole bunch at the Hinchman House but I was the union president here last year battling the battles I battled. Between that and the struggles of being a teacher under the gun and having my three year, thirty-two pound, behemoth over there playing in the sand, I stepped back from Maria Mitchell but was actively involved for a while with Janet and Darcie and the whole gang down there. I've been to Hinchman House. I wouldn't have joined the board if I hadn't. I have the utmost respect for it. Matt was in the same situation. We both had our kids and life turned a different corner.
MC: Having seen the Hinchman House, do you think that it incorporates enough of the STEM topics?
MG: STEM topics being?
MC: Science, technology, engineering and math.
MG: I don't know that it does, really. I'm not sure when you talk about that, like if Hinchman House does. It's mostly natural science. I think you're talking about different, like mathematics and other stuff you're trying to incorporate.
MC: We know that they don't cover the engineering or the math portion but you think it covers the science or do you think it needs to include more of that.
MG: I think it could include more, personally. I think Hinchman House is great but I think it could include more. I think it focuses on one broad, a large chunk of life science but I don't think it necessarily looks at Earth science as well as it could or other strands.
ML: Yeah.
MG: Does that answer it?
MC & VV: Yes.
MG: I think it could broaden a bit.
ML: They definitely could. I agree. Again, I think because E.S. Andrews had such influence when they were setting that up, and Dr. Kennedy's strength is ornithology, I think that's why they've got all the birds.
MG: That's right and they've got Verne Laux now.
ML: I think if they just kind of were more open-minded to the different life sciences and if you brought in some of the earth sciences, the geosciences—
MG: Or oceanography.
ML: That would be great. They were asking if I had come down to the Hinchman House. I said "Yeah, I was on the board for two and a half years, had a kid, joined a union, screwed up everything and had to leave." Here we go. Alright.
VV: Ok, so what do you think you'd like to see in the museum in terms of geoscience and oceanography? We need ideas that aren't our own so we could justify ourselves in putting them in there.
MG: I would love to see the changing shoreline.
ML: Yeah, something about the changing shore or erosion.
MG: I have a phenomenal map in the closet there
VV: He has a map! We were thinking about this and the fact that you have maps makes it even better.
MG: You could have this one map. It's really cool. It's of Nantucket's changing shorelines. I'll give it to you. You can have it. It's from the town. I'll give it to you right now. I just think that the island's shoreline changes are so dramatic and we're talking about how it ties in everything from global warming to erosion to coastal currents to everything. This map shows what it was like 150 years ago. It's all color coded.
ML: Yeah, so a map like that and then in conjunction with that topic… about erosion, the literal drift, and the currents. I'd love to see something about the sea floor topography done because the shoals off the west end are rather famous from the whaling days because of the treacherous waters.
MG: This isn't great quality. It's not exhibit quality for you. I used to have this for yeas an aerial photograph of Tuckernuck but if you look at the dating of years. It's so simple to use but people go, "Oh my God!" They don't realize that it was once joined. There was a spit of land in 1846 that ran with the whole southern shore of Tuckernuck totally buffering it. It was like a barrier island.

ML: Ooh, that’s very cool!
MG: I don’t think there’s enough of that down at Maria Mitchell. I’m may be wrong. You probably know more about that than I do. I just think the shoreline of Nantucket is such a topic of interest out here, from that houses that fall in every winter. That’s one thing that we could do.
AT: What’s this? Made ten years ago?
MG: That map is probably more than that. Is it? What’s it say?
AT: 1998.
MG: Yep, there you go. August 4, 1998. You could take it and use it if you want.
ML: If you don’t take it, I’ll take it.
AT: They have something like this. They have the hallway that just has four panels only they don’t show overlapping. You have to look back and forth.
MG: This is really user-friendly.
AT: It’s really hard to see the difference of changes. You can see the major changes like this but you can’t see these tiny ones like that.
MG: I got that from the guy, Hilliard downtown. He does the mapping for the town. He’s in the building across from the town building.
VV: Does he do GIS type things?
MG: Exactly. It’s in the building. Federal, the town building’s down here, Broad Street’s there. He’s in that house there where they do a lot of the town payroll.
AT: What’s his name?
MG: Dalton. Is it Dalton Hilliard?
MC: One idea we were discussing is sort of similar to this. We were going to try to see if we could get copies of old maps and make an overlay but we were going to do is make it more visual, like a TV. Something like that.
MG: A Power Point thing. Oh, it’s an ongoing thing?
MC: Do you think that’s something that would be accessible to the kids?
MG: Yes, absolutely. I’ve shown this [referring to map] to my kids this year. I show it to them every year and fifth graders look right at that and they’re so familiar with the shape of the island, it’s unmistakable now. They make cutting boards out of it for God sakes and sell them in the summer time. They look at that and go, “Oh!” They can pick where they live, especially the ones that live closer to the shore, north, south, east, or west. The town harbor, the finger points. It’s totally understandable to fifth grade kids. There’s not a kid that doesn’t go, “My God, look at that!” If you did something like that, that was ongoing and museum quality, I’d love that. Is that good?
ML: Yeah, they love the interactive stuff. The map at the new shipwreck museum that they have, you press the button and all the different shipwrecks slide up. You had to peel them away from that.
MG: That’s why that map’s being repaired out there because my class busted it last year.
MC: Just for clarification, some of the obstacles that are preventing you from going right now are…
ML: Cost.
MC: Cost for you and just time because the whole public school system…
MG: Yeah, you know, I think they’re just teaching to the test. I think that there has been a climate where, “What do you mean you’re going to take a half a day to go and walk through the woods and collect salamanders?” There just should be something said that you don’t have to tie everything into a document. For instance, this year we were studying Native Americans, the early inhabitants of the Americas. So we built these little Native American structures. It’s totally cool. We did these and this is like old day science. This is social studies. The kids would go outside and collect all these little things. The kids use a glue gun. They put together these little structures. It’s totally cool. It is fun; just using leaves and that made them think what it was like for the Native Americans. A friend of mine who works for the Conservation Foundation here, they have land now that they’re turning into grazing land so they have sheep and you’ve got about fifty sheep. She said, “Hey, Mike, we’re shearing the sheep if you want to bring your kids up.” They have this guy come down twice a year from this farm in Vermont and he’s a professional sheep

shearer. I was like, “Ooh, we could tie this into warmth and clothing.” I mean, the Native Americans didn’t use wool per se. They would wear animal skins and whatnot but I took my kids out and had the go-ahead from my new principal, our old new principal. He said, “Oh my God, Mike, you’ve got to get them out.” We hopped on the bus. We went out and spent two hours. The kids sheared sheep. They’re why I’ve got wool there on those shelves. It was just this dead calm quiet. They were just mesmerized by this guy. He could talk, he had a great sense of humor. I thought you don’t have to tie everything to the curriculum. These kids now know that when they pull on a sweater, it started on that animal that gets sheared twice a year, that the world record is 738 sheep in a day. It is. They learned all this stuff and they learned about the lanolin, how the guys have to wear special pants and shoes because they get it destroyed. Even a tough pair of Levi’s wouldn’t stand up to it. Is it tied into the frameworks? No. Did the kids learn something really cool that was stuck in their minds? Yes. The kids that thought it was cruel, all of a sudden realized that the sheep were happy and that this guy had a way with them. It’s like the horse whisperer now it’s the sheep whisperer. It was good. Anyway.
MC: Do you have any conflicts besides just cost for your school since you’re outside the whole public, mandatory, teaching the test…
ML: No, really just recently it has been cost that’s held us back from Maria Mitchell. When we do the wetland unit we get out to Consue Springs. I always give Darcie a call and we get someone to come along from Maria Mitchell and when they said it was $120, at the time I was actually a board member too and I said, thanks but no thanks. Well maybe we can get Dr. Kennedy to come do it at a discount. It was out of principle I said no thanks. I picked up the phone, called up Land Council and it was just like, “Oh, I can’t wait. It’s awesome. We can do that.” To defend Maria Mitchell, they have a bottom line and they have quite a bit of overhead so I can understand
MG: Way more than any other organization out here.
ML: What I’ve picked up from being on the inside, I understand the camps have taxed the association quite a bit from the summer. We have more and more and more summer camps and we get three rainy days and you guys are inundated with busloads of kids from four or five different major camps out here so they had to start charging kids. They had to
MG: Absolutely.
ML: If a camp or school wants to pay a $50 membership fee and from there on out, every kid pay a dollar, I thought that was reasonable but I still, and I don’t mean to gripe, $120 for two hours is just ridiculous. That’s just not right.
VV: How is your school structured? You were mentioning there’s a class of three kids and each class is smaller than eleven. How many are there in the entire school? How many grades ?
ML: At school we do pre-K, three-year-olds and four-year-olds. Class size is never to exceed sixteen. All the younger grades actually from three-year-olds all the way up to fourth grade are sixteen to a class. Then there are some of the older classes, like this year’s eighth grade that’s three students. It’s really an anomaly. It’s kind of a carry-over when the school first started back in ‘83. These kids have been together. When they were together, they did some work with the sixth grade, some work with the younger grades and some work with the older grades to kind of put them in these classes where there were some more students so they could at least do some cooperative teaching, some cooperative learning taking place. Once they became eighth graders, they’ve kind of been on their own.
MC: So we’re working on our project, we’re trying to get schools to come, to get groups of kids to kind of come in and walk through the museum and have a tour and sort of give them a chance to sort of play with our prototypes so we can modify them and make them as effective as possible. Do you think it’d be possible to get your kids in?
MG: Absolutely.
ML: Yeah.
MG: We’d love that.
ML: Jo already wants to, too. We’ll get sixth grade.

MG: I know that we could do it this year. It's totally cool. We can start tomorrow and I have a nice group of kids this year, like their appetites for stuff is just awesome. They'd love to have a part in the process.
VV: How will transportation work and all that because we don't have anything?
MG: We walk and it's easy. It's an easy stroll.
ML: We have parent drivers.
VV: Ok.
ML: The eighth grade that I would bring again, the three can fit in my truck. The seventh grade with eleven kids, I'll get another parent driver to come or someone I work with has a van. I'll throw them all in the van. I'll let Jo deal with the fifth and sixth grades if you want all those kids.
VV: We're aiming mostly toward K through 6. The museum itself is aimed toward a lot of four-year-olds who come in and we want to bring it up a little but we don't want to bring it up too much.
ML: OK, so K through 6. I'll keep my three eighth graders and I'll push for Jo to get her fifth and sixth graders there. Absolutely and if you want more, let me know—
MC and VV: Yeah.
ML: and we'll talk—You do? As many as possible? Below fifth grade they're all self-contained classrooms. First grade, third grade, so it's just one teacher I'd have to go to and say, "During your science during this day would you do this?" Is that something you're interested in talking to them about? Ok. Next Tuesday, I have a math/science meeting at school. I can bring it up then if that works for you guys. I will talk to Jo and pass on your email to Jo tomorrow morning. You can get right on with that at the fifth and sixth grade. It's just, even though we're in a tiny one room school house, everyone gets going in their own direction. I'll just have to check and see if I can talk to the kindergarten, first, second, third or fourth. I'll try but I can guarantee you I'll address this with them on Tuesday hopefully before then.
VV: That is excellent.
MC: How much leeway time would you need or like time to plan an actual day?
MG: A day of coming down?
AT: Yeah.
MG: You want us to spend the day?
VV: Not the whole day. We just want to know where to schedule you in.
MG: Pick a day next week. I can have that done. If you want, time is of the essence. I can do a quick field trip form home and the ones that don't come back in time I just call the parents and say, "May I get a verbal?" and they say yes.
MC: Well because we're doing this project and we need to observe the kids and we need to observe the way they're interacting, we have a form that we need to get parental approval.
VV: It's a specialized form.
MG: You got it.
ML: I'm sure Jo can find a way to get her kids in there before Thanksgiving. That's this week and next week. Before the end of next week if that's what you want. We have the Lighthouse School coming in on Tuesday so that's kind of busy. We're using the rest of this week planning our prototypes and getting them done then. We're going to actually be gone the week of Thanksgiving.
ML: Ok.
MG: So is nothing available next week?
MC: Maybe next Thursday.
MG: Thursday or Friday. It's fine with me.
MC: Well Friday we have to leave to catch a ferry.
MG: Gotcha. Next Thursday's good.
ML: Again, I've got to talk to Jo...

Appendix C-14: Interview with Lighthouse School Teachers Notes

Molly's Notes

- lots of kids in small space
- Hinch. is contrary to kid's wants : touch
- items taller than kids
- ocean worked the best
- make bird room more of a find the ____
- Lisbet: dead things don't tell much to children; not best presentation
- enjoyed room w/ living animals
- Lisbet: useful to see the animals up close
- birds?
- ongoing film of osprey? cameras on nests
- kids remembered more from book
- have group come for 1 room only; focus on topics in room
- children museum. action (outside BOS). Odor room
- Lisbet: Aquarium hit
    - touch tank
    - small size(not overwhelming)
    - all live creatures
- parents want places to entertain kids
- "sound would be good"
- coloration - male & females
- family mama, papa, nest (home)
    - let kids build own nests
- Lisbet: children need to touch and then talk on tours
- "reading is hard for kids, it's work"
- "more than a sentence" might be too much
- Lisbet: kids enjoy someone having expertise in a subject/specific animal
- give kids a question/thing to find in each room
- give kids time to wander as well as scheduled events
- Lisbet: structured stations @ specific time and free time
    - something for parents so they can answer questions
    - create a little habitat
- "little guys don’t have the word for it" just watching the interaction is enough
- things for them to play and get into is a big hit
- "so overwhelming" bird room
- theme or storyline
- plant and take home
- "kids loves to take stuff with them"
- "make it more focused"
- expensive

- "have never heard anything special about it"
- Lisbet: "seems like they see it as a museum of a museum"
- NHA - whaling museum renovations $ but managed to keep feel

Victoria's Notes

- kinderclass
- claws (really liked)
- need to be able to touch
- height issues
- marine room works best
- scavenger hunt: find things w/ blue feathers
- Lisbet:
    - dead things
    - doesn't give information about habitat/ how it lives
    - not beset for kids
    - useful to see birds up close
- create life
    - birdfeeders outside
    - separated by type
- matching sounds to birds
- ongoing film/video
- focus on shorebirds/songbirds --> storybook
- tailor each room to an age
- wanted to stay
- children's museum in action
    - room (discovery)
    - rooms by age
- MMA aquarium
    - touch tank
    - perfect size
    - not overwhelming
- parents desperate to engage
- sound
    - colorations (even as a story)
    - relate to families
    - build your own nest
- look around; then talk (tour)
- ask questions
- reading labels: too hard for most
- for kids, an hour is a lot
- Mt Desert Oceanarium

    - signed up on ticket to locations @ specific time
    - optional talks
    - stations
    - parents can read & lead children
- create habitats
- water erosion (just watch)
- should be able to get concept briefly
- talked about it afterward: dead snake
- change collections
    - create themes
    - herb garden (taste)
    - plant something and take w/ them
- teachers:
    - too expensive
    - every season something new
- NHA Whaling Museum: changed but more interactive "fresh coat of paint"

Appendix C-15: Response to New School Teacher Feedback Form

What science topics do you teach in your class?

_Rocks and Minerals (characteristics in the Earth's crust, the role of a geologist, the rock cycle, 3 different types of rocks, identify properties used to identify minerals)
_Arachnids vs. Insects (body parts and functions, life cycle, characteristics, different types, habitat)
_Sun, Earth, and Moon (phases of the moon, the relationship between the sun, the Earth, and the moon, gravity, the moon's physical characteristics, eclipse, traveling to the moon)
_Metamorohosis (the life cycle of a Tenebrio Beetle (Darkling beetle, mealworm), habitat
_Plants (life cycle, plant structures and functions, photosynthesis, plant cells, seeds)

____

Do you feel that field trips to the Natural Science Museum would enhance your curriculum? How?
__Yes, they have supported my science curriculum on arachnids.
__ Our study on the earth and plants – soil erosion, weathering
___We also study the history of Nantucket, so a field trip would certainly relates to our island and how it is a habitat for many creatures.
__Maria Mitchell (we study famous people from MA in social studies)

____

What topics do you believe are covered well by the Natural Science Museum?
__Birds that live on Nantucket
__Erosion on the island

____

What topics do you believe are missing from or are not covered well by the Natural Science Museum?
____It would be great to have some rocks and minerals found on the island with a microscope to look at them more
closely.____
____

Do you feel that the bird feet adaptation exhibit was beneficial to your students? How?

___Yes, they enjoyed the hands-on experiences of both the beak and the feet centers. I think it would have been more beneficial to have smaller groups of students with more adult questioning to guide students through the process. Students came into the exhibit with little prior knowledge, so the guided discussion may have helped students to stay focused on what they were doing and make the connections to how birds use their beaks and feet out in nature. I believe that if just 2-4 students were around each center, students could really focus on what the center was about and make comparisons between actual birds in nature. With more time, they could look closely at an actual birds in the case that had claw feet vs. webbed feet, long beaks vs. short beaks, and then discuss how they adapt in nature. This may help student make connections and gain a better understanding of how animals' characteristics help them in the world they live in.

____Maybe they should have a scavenger hunt?

____Students could break into smaller groups….one group could be in the live animal exhibit room, one group could be in the weathering on Nantucket room, and one small group could be in the bird room…

____

Do you feel that the bird beak adaptation exhibit was beneficial to your students? How?

_______Yes, students enjoyed seeing and feeling how different bird beaks effect the way the different types of birds get their food.

____

Do you feel that the erosion book was beneficial to your students? How?

____Yes, but it would be great if there were some type of hands-on center in this room as well, so that students could see how erosion works. They enjoyed the visual of the picture book.____

What do you believe the Natural Science Museum can do to improve its current exhibits?

____Unsure at this time…

What are the obstacles that keep you from going on field trips to the MMA?

____I've taken my third grade to the MMA two times (Once for this past field trip to check out the new exhibits and once for arachnids.) It would be nice to know what programs are offered for different grade levels to support the curriculum. Do the programs change every year? Is the MMA willing to create a new program to support specific science units of study? (for example, rocks and minerals)

____

What is the process for proposing a field trip entail?

___Teachers decide if the field trip would support the curriculum taught and it is supported by the administration._Then we just need to find parent drivers.

____

How are field trips arranged at your school? Does the school cover the cost completely or do the parents pay a certain amount for a given trip? Please explain.

____It depends…for on-island trips, it generally doesn't cost anything except for the gas in cars, which parents pay for. For off island trips, we usually fundraise and parents pay the difference in cost. The ferries give us a special deal for field trips.

____

What would the Maria Mitchell Association need to do to attract your class and/or school to the Natural Science Museum?

___Let us know if there are any programs which will support the curriculum and be appropriate to each grade level.

____

____

____

Thank you!

Appendix D: Surveys

Appendix D-1: Open House Feedback Form

Circle what grade are you in?   K 1 2 3 4 5 6   NA

How much did you enjoy your stay at the Natural Science Museum?
(Circle a number. Nine is excellent. One is very poor.)
1 2 3 4 5 6 7 8 9

Rank the following rooms from your favorite to your least favorite, where 1 is your favorite and 5 is your least favorite.

General Ecology Room ______
Bird Room ______
Marine Room ______
Live Animal Room ______
Main Room ______

Why was your first choice your favorite?
____
____

Why was your last choice your least favorite?
____
____

Did you find the exhibits interesting?   Y   N

On a scale of 1 to 9, how easy was it to understand the exhibit ideas?
(Circle a number. Nine is excellent. One is very poor.)
1 2 3 4 5 6 7 8 9

Which displays were easy to understand?
____
____

What displays did you find difficult to understand?
____
____

Which display did you like best?
____
____

SEE REVERSE SIDE

Why did you like that display?

____

____

Which display did you like the least?

____

____

Why did you like that display the least?

____

____

Which topics would you like to see in the museum?

____

____

Do you think the Natural Science Museum should be more hands-on? Y N

Additional Comments:

____

____

____

____

Appendix D-2: Prototype Feedback Form Version 1

Prototype Feedback form for Museum Visitors

Circle what grade you are in: K 1 2 3 4 5 6 NA
Did you like the erosion book? Y N
Did you like the bird beak exhibit? Y N
Do you think the bird beak exhibit was easy to use? Y N
Did you like the bird claw exhibit? Y N
Do you think the bird beak exhibit was easy to use? Y N
Which exhibits would you like to remain in the Natural Science Museum?

____

____

____

Was the wording too difficult to understand? Y N
Were there too many words? Y N
Are there any topics you would like to see in the museum?

____

____

____

Additional Comments:

____

____

____

Appendix D-3: Prototype Feedback Form Version 2

Prototype Feedback Form

Circle which grade you are in: K 1 2 3 4 5 6 NA

If one is very poor and five is very good, please circle a number for each of the following questions

How much did you like the erosion book? 1 2 3 4 5

How much did you like the bird beak exhibit? 1 2 3 4 5

How easy do you think the bird beak exhibit was to use? 1 2 3 4 5

How much did you like the bird claw exhibit? 1 2 3 4 5

How easy do you think the bird claw exhibit was to use? 1 2 3 4 5

Which exhibits would you like to remain in the Natural Science Museum?

____

____

____

How easy was the wording to understand? 1 2 3 4 5

Were there too many words? Y N

Are there any topics you would like to see in the museum?

____

____

____

Additional Comments:

____

____

____

Appendix D-4: Prototype Feedback Form Final Version

Prototype Feedback Form

Circle which grade you are in: K 1 2 3 4 5 6 NA

How much did you like the erosion book? 1 2 3 4 5
Very poor Very good

How much did you like the bird beak exhibit? 1 2 3 4 5
Very poor Very good

How easy do you think the bird beak exhibit was to use? 1 2 3 4 5
Very hard Very easy

How much did you like the bird claw exhibit? 1 2 3 4 5
Very poor Very good

How easy do you think the bird claw exhibit was to use? 1 2 3 4 5
Very hard Very easy

Which exhibits would you like to remain in the Natural Science Museum?

____

____

____

How easy was the wording to understand? 1 2 3 4 5
Very hard Very easy

Were there too many words? Yes No

Are there any topics you would like to see in the museum?

____

____

____

Additional Comments:

____

____

Appendix D-5: Prototype Investigation Packet Version 1

How is a duck's bill like a comb?

____

____

Which is the smallest bird in the bird room?

____

____

Why couldn't a woodpecker's beak be soft?

____

____

What is a whale's baleen used for?

____

____

What are some causes of erosion?

____

____

How are drift seeds carried onto Nantucket?

____

____

What kind of bird feet are best for swimming?

____

____

Why do many birds have claws?

____

____

Why does a shorebird need a long, pointed beak?

____

____

Appendix D-6: Prototype Investigation Packet Final Version

How is a duck’s bill like a comb? ____

What is a whale’s baleen used for? ____

What type of food do birds with short, hard beaks tend to eat? ____

What are some causes of erosion? ____

How are drift seeds carried onto Nantucket? ____

What kind of bird feet are best for swimming? ____

Why do many birds have claws? ____

Why does a shorebird need a long, pointed beak? ____

Appendix E: Survey Raw Data

Appendix E-1: Open House End Survey Numerical Data

Circle what grade you are in.							
Grade	**K**	**1**	**2**	**3**	**4**	**5**	**6**
Number of Responses	2	2	3	3	0	1	1

Grade	**N/A**
Number of Responses	10

N/A Breakdown	2 pre-school	1 blank
	7 adults	

How much did you enjoy your stay at the Natural Science Museum?							
Number Scale	**1 (Poor)**	**2**	**3**	**4**	**5**	**6**	**7**
Number of Responses	0	0	0	1	2	4	4

Number Scale	**8**	**9 (Great)**
Number of Responses	1	9

Rank the following rooms from your favorite to your least favorite.						
Ranking		**1**	**2**	**3**	**4**	**5**
Room	General Ecology	1	1	5	6	3
	Bird	6	4	4	1	1
	Marine	0	1	6	5	4
	Live Animal	10	2	1	1	2
	Main	1	1	0	5	9

Did you find the exhibits interesting?	Number of Responses
Yes	19
No	1

On a scale of 1 to 9, how easy was it to understand the exhibit ideas?							
Number Scale	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Number of Responses	1	1	0	2	1	1	3

Number Scale	**8**	**9**
Number of Responses	1	11

Do you think the Natural Science Museum should be more hands on?	Number of Responses
Yes	15
No	2
N/A	4

Appendix E-2: Open House Survey Open Ended Question Data

Why was your first choice your favorite?	I liked holding the garter snake
	Well heck-- I'm the bird guy.
	I enjoyed learning about the live animals.
	BLANK
	I never touched a snake before
	Live animals because I like observing how animals move and how they look
	The live animal room
	I like live animals
	Live animals, and a guide to explain and answer questions
	Always find live exhibits the most interesting
	Many different animals, a stuff[ed] rabbit
	The stuffed birds look very realistic. It looks like they're alive-- minus the moving.
	It helps with identifying the birds that I see
	Because I can actually see/learn about the live animals. I just wish there was some more animals.
	Interactive
	Snakes!
	Kids loved to hear about all rge snake info, etc.
	Good commentary
	Spiders, snakes, turtles, frogs
	Because it's fun to watch then (sic) move around
	Lots of neat stuff, stuff I didn't know, interesting facts

Why was your last choice your least favorite?	BLANK
	Mish-mash. Needs ecological theme- connections!
	Because it's the emptiest room
	BLANK
	Bird room
	Main room because you basically don't learn anything
	Main room.
	There are no animals
	It was uninteresting in general, limited exhibits.
	Everything is interesting but somethings has to come last-- also very familiar with the birds since we feed them in the yard at home
	I see it more as a gift shop, not an exhibit
	Snakes…
	Exhibits get lost or overwhelmed by the gift shop and you tend to pass by on the way to the other exhibits
	Because I don't think they showed a lot and I just was not into it.
	Not so much to learn about
	I see shells everywhere in world
	BLANK
	BLANK
	Not as interesting
	Because it 's fun to watch them move around.
	Not a lot of stuff, unorganized

Which displays were easy to understand?	The Marin[e] room
	Birds of a feather, Drift seeds
	Matching marine objects.
	Live
	Snake
	All of them were pretty easy.
	All
	Most of them
	Live animal room, well documented w/ an interpreter
	Bascially everything
	The marine room, clearly labeled
	The plant display with the light buld and wires
	Live animals -- there usually is an interpreter there
	The bird displays.
	All of them
	BLANK
	Shells.
	Most
	Spiders
	We A lot of the live animal exhibits.
	Pictu[r]es, maps, table w/ elevation

What displays did you find difficult to understand?	None
	Seaweed & algae-- hobby? --> Not tied together
	It looked like the cages were empty.
	Birds
	BLANK
	None
	None
	None
	Main room, the astronomy display
	More information about the birds would be helpful
	In ecology room, not as clearly labeled, used scientific name, not general name
	For many displays it is difficult to determine what guests are allowed to touch
	All of the labeling could be improved. Type is too small, ideas could be made more relevant
	Nothing really.
	BLANK
	BLANK
	Birds
	BLANK
	American Burying Beetle
	Some of the whale exhibits.
	Displays w/ title higher than eye level, captions that are small, distracted by scientific name

Which display did you like best?	The Live animal room
	Turtle tank-- snakes.
	The turtles and the frog
	Turtles
	Whales
	Live animal
	The turtles and frog and the snakes
	Milk snake
	All of the live animal room
	Turtles & frog-- also spiders
	The ocean layers in the marine room
	The falcons
	The case with the mounted birds
	The live animal room.
	Snakes
	Snakes
	Live animals
	American Burying Beetle
	Marine
	The Milk Snake display
	Evolution of island geography

Why did you like that display?	Because I liked holding the garter snake.
	BLANK
	Because they were alive.
	BLANK
	BLANK
	Because I like to observe the animals.
	Because frogs, snakes, and turtles are cool.
	What they do to farms
	Live animals with explanations
	Always good to see live exhibits of things you can see in the local environment-- ponds, backyards, etc.
	Colorful, eye-catching, learned about Nantucket ocean areas
	They look very realistic
	It's been there forever! Again-- labeling could be better
	BLANK
	Like to feel snakes
	I love snakes
	Very informative
	Commentary from staff
	I love ocean
	Because I like snakes and it's surprising that there (sic) so big.
	Interesting, easy to interpret

Which display did you like the least?	None
	BLANK
	The bird eggs display.
	BLANK
	BLANK
	General ecology room.
	The black widows
	Ded (sic) rat
	The birds' nest.
	The dead rabbit
	The live animals that have no tops, where were the animals
	Snakes.
	Invasive plant species-- should have photographs-- hung too high, Arrowheads & archaeology stuffed in a corner
	BLANK
	Can't say, we liked them all
	BLANK
	BLANK
	BLANK
	American Burying Beetle
	The maps in the General Ecology Room.
	Random, unlabeled items

Why did you like that display the least?	None
	BLANK
	Because they look a lot alike
	BLANK
	BLANK
	Because there's not much in that room.
	Spiders are scarey (sic).
	It is ded (sic).
	It was very difficult to differentiate. Very little interest.
	Prefer rabbits to be alive
	Didn't know where the animals were
	Snakes.
	See above.
	BLANK
	BLANK
	BLANK
	BLANK
	BLANK
	Don't know about it
	Because I like 3D maps better.
	No thought as to why this is interesting

Which topics would you like to see in the museum?	Trees
	BLANK
	The salt marsh.
	BLANK
	Cat fish
	More animals
	Fossils and fish
	More pichshrs (sic)
	More on astronomy, lunar effects on fauna
	More live exhibits in general
	Larger animals, wuch as deer
	Astronomy
	Effects of erosion
	BLANK
	More interactive displays
	BLANK
	BLANK
	More about seals, deer and other Nantucket wild animals
	Plants, mamles (sic)
	Fish, more amphibians and mammals.
	History of Nantucket

Additional comments	None
	BLANK
	I would like to see more live animals.
	BLANK
	Learned whale is 2X larger than a dinosaur
	It was cool.
	None
	BLANK
	Nice survey, best of luck with your project.
	Great resource for Nantucket
	BLANK
	BLANK
	Text & photos need to be made more relevant. Coul have more butterflies & insects and more flowers, although that is difficult at this time of year.
	BLANK
	Thank you very much
	BLANK
	More animals
	Would be helpful to have videos or live cams of moor (sic) animals living/feeding in their natural habitat. Cameras could communicate to displays in museum
	Loved it!
	None
	Better captions. More organization

Appendix E-3: Lighthouse School Investigation Packet Data

Appendix E-3.1: Lighthouse School 1st and 2nd Grade Data

Question	1/2nd Grade Answers (9 kids)
How's a duck bill like a comb?	2 blanks
	because it can filter food
	because it combs the sand
	faltrs(sic) [filters]
	faltrs(sic) [filters]
	to filter food
	beckuse(sic) [because] it filters out water
	because it filters
Which is the smallest bird in the Bird Room?	4 blanks
	ruby hummingbird
	huming(sic) birds
	huming(sic) birds
	rody [ruby] hiting [humming] brid [bird]
	robey [ruby] hiting [humming] brid [bird]
Why couldn't a woodpecker's beak be soft?	3 blanks
	the uming bird {to the wrong question}
	?
	faltrs(sic) [filters] {to wrong question}
	faltrs(sic) [filters] {to wrong question}
	because it would brack [break]
	because it could

What is a whale's baleen used for?	6 blanks
	a filter
	to eet [eat]
	filtrigr [filter] planctin [plankton]
What are some causes of erosion?	7 blanks
	storms
	waves
How are drift seeds carried onto Nantucket?	7 blanks
	goallf [gulf] streem [stream]
	wavs [waves]
What kind of bird feet are best for swimming?	2 blanks
	webed [webbed]
	webed [webbed]
	webed [webbed] feet
	webd [webbed]
	bucs [duck's]
	webed [webbed]
	webed [webbed]

Why do many birds have claws?	2 blanks
	to hagon [hang on] to trees
	to grab on to beran chis [branches]
	so they can catch prey
	to catch stuf [stuff]
	to cach [catch] here [their] pr [prey]
	to catch pray [prey]
	so they can kill pray [prey]
Why does a shorebird need a long pointed beak?	4 blanks
	to reech [reach] under the sand
	to go beep [deep] boun [down]
	to get food
	to catch food deep down
	so it can rech [reach] down into the sand

Appendix E-3.2: Lighthouse School 3rd, 4th, 5th Grade Data

Question	3/4/5 Grade Answers (15 kids)
How's a duck bill like a comb?	10 blanks
	it filters things through it
	because it can sort through sand like a comb
	not sure
	because the sand went out just like water go's [goes] out of the little holes in the side of their mouth
	because it sifts through the sand to pickout food like a whale
Which is the smallest bird in the Bird Room?	2 blanks
	ruby throated humming bird
	ruby huming(sic) bird
	I never saw it
	ruby throted [throated]
	ruby throated humming bird
	ruby thote huming bird
	it was brown
	ruby throated huming bird
	rubie throghted humming bird
	ruby throated humming bird
	ruby throted [throated] humming bird
	a humming bird
	not sure

Why couldn't a woodpecker's beak be soft?	2 blanks
	because it wouldn't be able to peck deep enough to get small bugs
	it won't go into the wood
	it wood [would] not work
	because it would not work to brake through the wood
	because it would colapse [collapse]
	because it cudin [couldn't] get to its food
	because they need it to get in trees and get bugs out
	it couldn't get food under the bark
	because they would not be able to get in the bark
	because it has to peck through the wood

	because it would crack when it would peck at trees
	it would break on the wood
	because it has to peck through bark

What is a whale's baleen used for?	7 blanks
	one thing they used to use it for back in the 1800's is that women would were [wear] balleen [baleen] around their waist to make them look smaller but there are other uses
	to catch its prey its [it's] almost like a comb
	sucking in plankton instead of other foods it can't digest
	filtering kril and ocean water
	to ceep [keep] the fish in its mouth?
	for filter feed on krill
	to sift through plankton like a ducks bill
	caching [catching] it food

What are some causes of erosion?	2 blanks
	waves, wind and storms
	wind storms waves
	when the waves crash on the beach it takes sand away
	waves, wind and storms
	water
	storms
	a sorm [storm]
	water
	storms, waves and wild
	storms, waves and wild
	wind and waves and storms
	storms that make the waves bigger so they hit the dunes
	wind and waves

How are drift seeds carried onto Nantucket?	12 blanks {don't think it was covered on their tour}
	they float
	wind?
	the wind carries them
What kind of bird feet are best for swimming?	1 blank
	webbed feet
	ducks because they live near the water. Penguens [penguins] also because they live near water
	webbed feet
	webbed feet
	webbed
	webbed
	webbed feet
	duck feet
	duck
	webbed feet
	a duck, pagen [penguin], cormeran [?], swan am and sea gell [gull]
	ducks
	webbed feet
	webbed feet

Why do many birds have claws?	1 blank
	to catch things
	to grab their food
	so they can catch there [their] pray [prey]
	so they can cetch [catch] fish and mice
	to grip on to prey and branches
	to grab prye [prey] and brantshes [branches]
	to hang on to branches
	to take away meditors [?]
	to catch there [their] pray [prey]
	to perch on branches and dig out food
	to catch there [their] prae [prey] and grasp on to trees
	to grasp on to branches and to catch prey
	to perch and hunt
	because they are carnivorus and need to grip branches

Why does a shorebird need a long pointed beak?	3 blanks
	so they can dig in the sand to get food
	to stick it around in the sand to look for food
	to get into the sand and get bugs
	to dig into the ground
	because it can go into the sand farther
	to get their beaks under the sand to get food
	to get to its food
	so they can dig deep into the sand to pick in [it] out
	because it needs to catch clams
	to reach deep into the sand and get food
	so it can pick up different small things to eat
	to reach down and get bugs

Appendix E-4: Lighthouse School Prototype End Survey Open Ended Question Data

Which exhibits would you like to remain in the Natural Science Museum?	I think everything we saw today was beneficial to the students. The bird beak exhibit is an excellent idea but I could envision someone "stabbing" their hand through nothing but "childish behavior." The bird claw exhibit was really interesting.
	All.
	All of them.
	The spider and snake exhibits.
	ALL of them.
	I would like all the exhibits to stay.
	All of them
	I liked 2 exhibits in the Animal room and the Bird claw room.
	Live exhibit
	I would like the Live animal room to remain, and the bird beak exhibit.
	I really like the room where all the spiders are and where the depths model was.
	?
	The erosion and dolp[h]in and flowers and birds.
	Reptile and arachnids ex[h]ibits
	BLANK
	All of them
	I liked the animal room a lot. I never [k]new that some of the most lived on Nantucket. I also liked the owl pelite (sic) room.

Are there any topics you would like to see in the museum?	I really enjoy the way this museum focuses on such local topics and how specific they are to birds, fish,insects, reptiles and topography of Nantucket.
	Tropical fish
	None.
	BLANK
	I would like to see them all.
	Maybe some of the trees and more plants.
	None.
	X
	Pictures of Maria Mitchell
	BLANK
	More aquatic life
	BLANK
	More erosion and fish
	Sharks
	BLANK
	Yes
	I would like to see a baby shark.

Additional Comments:	Thanks for having us and for developing such thoughtful exhibits.
	BLANK
	BLANK
	BLANK
	No comments.
	BLANK
	I really like the museum a whole lot.
	Live exhibit was the best
	BLANK
	No.
	BLANK
	Thank you for having us!
	I loved the tour. Thanks!!!
	BLANK
	I loved the [w]hole museum!
	The assistants are really, really, really nice

Appendix E-5: Lighthouse School Prototype End Survey Numerical Data

Circle which grade you are in.						
Grade	K	1	2	3	4	5
Number of Responses	0	0	0	3	6	5

Grade	6	N/A
Number of Responses	1	0

	Number of Responses			
	Yes	No	Middle	N/A
Did you like the erosion book?	13	2	0	0
Did you like the bird beak exhibit?	15	0	0	0
Do you think the bird beak exhibit was easy to understand?	13	1	1	0
Did you like the bird claw exhibit?	13	1	1	0
Do you think the bird claw exhibit was easy to understand?	13	2	0	0
Was the wording too difficult to understand?	1	13	1	0
Were there too many words?	0	14	0	1

Appendix E-6: Mike Girvin's Class Prototype End Survey Numerical Data

Circle which grade you are in.						
Grade	**K**	**1**	**2**	**3**	**4**	**5**
Number of Responses	0	0	0	0	0	16

Grade	**6**	**N/A**
Number of Responses	0	1

	1	**2**	**3**	**4**	**5**
Did you like the erosion book?	0	3	6	6	2
Did you like the bird beak exhibit?	0	2	5	8	2
Do you think the bird beak exhibit was easy to understand?	0	0	5	3	9
Did you like the bird claw exhibit?	1	0	1	9	6
Do you think the bird claw exhibit was easy to understand?	0	1	2	5	9
Was the wording too difficult to understand?	0	0	2	5	10

	Yes	**No**	**Middle**	**N/A**
Were there too many words?	1	15	1	0

Appendix E-7: Mike Girvin's Class Prototype End Survey Open Ended Question Data

Which exhibits would you like to remain in the Natural Science Museum?	I think everything we saw today was beneficial to the students. The bird beak exhibit is an excellent idea but I could envision someone "stabbing" their hand through nothing but "childish behavior." The bird claw exhibit was really interesting.
	All.
	All of them.
	The spider and snake exhibits.
	ALL of them.
	I would like all the exhibits to stay.
	All of them
	I liked 2 exhibits in the Animal room and the Bird claw room.
	Live exhibit
	I would like the Live animal room to remain, and the bird beak exhibit.
	I really like the room where all the spiders are and where the depths model was.
	?
	The erosion and dolp[h]in and flowers and birds.
	Reptile and arachnids ex[h]ibits
	BLANK
	All of them
	I liked the animal room a lot. I never [k]new that some of the most lived on Nantucket. I also liked the owl pelite (sic) room.

Are there any topics you would like to see in the museum?	I really enjoy the way this museum focuses on such local topics and how specific they are to birds, fish,insects, reptiles and topography of Nantucket.
	Tropical fish
	None.
	BLANK
	I would like to see them all.
	Maybe some of the trees and more plants.
	None.
	X
	Pictures of Maria Mitchell
	BLANK
	More aquatic life
	BLANK
	More erosion and fish
	Sharks
	BLANK
	Yes
	I would like to see a baby shark.

Additional Comments:	Thanks for having us and for developing such thoughtful exhibits.
	BLANK
	BLANK
	BLANK
	No comments.
	BLANK
	I really like the museum a whole lot.
	Live exhibit was the best
	BLANK
	No.
	BLANK
	Thank you for having us!
	I loved the tour. Thanks!!!
	BLANK
	I loved the [w]hole museum!
	The assistants are really, really, really nice

Appendix E-8: Mike Girvin's Class Investigation Packet Data

Question	5th Grade Answers (16 kids)
How's a duck bill like a comb?	4 blank/?'s
	Because it sifts like a comb
	Because it sifts like a comb
	because it's long
	because it needs to sift the comb
	because it sifies [sifts] like a comb
	Because it sifts like a comb
	it is like the tines in the comb
	it sifts through the water and finds food
	because it filters the water and eats it's food
	because of teeth-like growths
	the come [comb] can move the big rock and not the sand and so can the duck bill
	because it has hairs

Which is the smallest bird in the Bird Room?	3 blank/?'s
	Ruby humming bird
	Ruby humming bird
	the ruby throught [throated] humming bird
	the ruby humeing [humming] bird
	Ruby humming bird
	ruby throated homing [humming] bird
	ruby-necked humming bird
	ruby throated humming bird
	ruby throated humming bird
	ruby throted [throated] numing [humming] bird
	ruby throated humming bird
	the ruby throated humming bird
	rodi throated ?

Why couldn't a woodpecker's beak be soft?	3 blank/?'s
	it wouldn't be able to peek [peck] into the tree
	because it could not peck the wood with a soft beek [beak]
	they use it to peak [peck] a tree
	because it needs to peck trees
	it couldn't be soft because then it wouldn't be able to peck into a tree
	because they eat bugs that live in trees and they need a hard beak to get to them
	because it couldn't cut through wood if it was soft
	because it couldn't peck through the bark for food
	because it would not be able to break into trees and get the bugs
	a woodpecker's beak wouldn't be soft because it peck's wood all the time
	because it has to get its food
	because if it was it would break when it would peck the wood
	then it couldn't would [wood] peck

What is a whale's baleen used for?	2 blank/?'s
	to eat the crill [krill]
	to eat crill [krill]
	to get krill
	to trap the creel [krill] inside it mouth and lets the water out
	sifting through the water and finding food
	it is the stuff that filters the water and keeps the food
	sifting for food
	the whale's baleen is used to filter big fish from krill
	getting the planton [plankton] in and water out
	catching krill
	to keep out water and bring in crill [krill]
	to sort there [their] food
	to seper-rate [separate] the water from the food
	to eat the crill [krill]

What are some causes of erosion?	1 blank
	the waves are a cause of erosion
	because of the water crasheis [crashes] agans [against] the hills
	water and wind
	water and wind cause erosion
	water and wind
	rising waters, bigger waves, storms
	the tide
	storms make big waves with their wind which drags the sand into the ocean
	wind, waves, water
	heavy waves
	wave crashing on the beach
	the waves
	waves and wind
	storms and waves
	wind and waves sometimes caused by storms

How are drift seeds carried onto Nantucket?	1 ?
	wind and water
	wind and water
	wind and water
	the Gulf current
	they drift through the water to Nantucket
	the Gulf current
	the tide
	wind
	by the waves
	the current
	by the water
	wind and water
	falling off trees near the ocean and drifting away
	the waves, wind and water current
	by the ocean

What kind of bird feet are best for swimming?	0 blank/?'s
	a duck's webbed feet are best for swimming
	ducks
	web [webbed] feet
	webed [webbed] feet
	web [webbed] feet
	webbed feet are good for swimming
	duck
	webed [webbed]
	webbed feet
	webbed
	webbed feet, because they push the water away
	webbed feet
	webbed feet are best
	webbed feet
	web [webbed] feet
	web [webbed] feet

Why do many birds have claws?	1 blank
	to grasp branches
	to hold on to branches and catch and ripe [rip] prey
	to catch and kill there [their] prey
	so they can grip on to the tree and not fal [fall] of [off]
	to cech [catch] there [their] pray [prey] or eat there [their] pray [prey]
	for grip a [and] caching [catching] food
	to cling to branches
	yes [guess he missed the 'why' part of the question]
	to perch on trees
	to grip trees and prey
	so they can grip prey and branches
	to grip on to trees
	so they can hold on to branches and prey
	so they can hold on there [their] Fray [prey]
	to hold on to branches and to rip out the inside of the prey

Why does a shorebird need a long pointed beak?	11 blank/?'s
	to reach into the water to cach [catch] fish
	to get scollaps in the ground
	to dig through ground for food
	to pick out the food in the sand
	to get food in the sand

Appendix E-9: New School Prototype End Survey Numerical Data

Circle which grade you are in.						
Grade	**K**	**1**	**2**	**3**	**4**	**5**
Number of Responses	0	0	0	13	0	0

Grade	**6**	**N/A**
Number of Responses	0	1

	1	**2**	**3**	**4**	**5**
How much did you like the erosion book?	0	0	2	5	6
How much did you like the bird beak exhibit?	0	0	1	3	9
How easy do you think the bird beak exhibit was to use?	0	0	3	3	7
How much did you like the bird claw exhibit?	0	0	2	4	7
How easy do you think the bird claw exhibit was to use?	0	1	2	1	9
How easy was the wording to understand?	0	0	4	8	1

	Yes	**No**	**N/A**	**Reason:**
Were there too many words?	2	9	2	1 blank; 1 w/ both

Appendix E-10: New School Prototype End Survey Open Ended Question Data

Which exhibits would you like to remain in the Natural Science Museum?	Bird claw exhibit, bird claw exhibit
	The bird beak exhibit and the claw exhibit. I think they should all be in the Science Museum!
	The ducks beek (sic) exhibits
	The one were (sic) you see the real animals and the main room
	Bird skulls, butterflys (sic), owls
	All of them.
	The room ware (sic) all the thing are alive and the bird room
	I would like to stay in the Bird claw ex[h]ibit (sic).
	The live animal ex[h]ibit and the skull exhibit
	The one with live animals and the one with all the stuffed birds.
	The bird exhibit and the exhibit with live stuff in it.
	The animal room.
	I do not [k]now at all. I Love all of them so I can not cho[o]s[e] 1 of them.

Are there any topics you would like to see in the museum?	A little more astranomicle (sic) stuff.
	The Bird beak exhibit and all of the exhibits in the Museum.
	No
	Arrow head and spear heads and to[u]ch tank or even a green house
	Deer skills, Alligator skulls, alligator skins, lions main [mane]
	Yes, the live creatures.
	Insects.
	?
	Not really
	A room with snakes and lizards that you can touch.
	No
	No
	The Bird beak exhibit

Additional Comments:	I like all of the spiders and turtle and frog and snakes.
	I loved it. It was fun and very ex[c]iting to see. I liked it a lot.
	No
	I really injoiyd (sic) the mammal book and you.
	It was fun to see the monarchs and the owls.
	It was great!
	It was really fun!!!
	?
	BLANK
	It hought it was great, I really liked the live animals.
	It was very fun
	BLANK
	BLANK

Appendix E-11: New School Investigation Packet Data

Question	3rd Grade Answers (13 kids)
How's a duck bill like a comb?	4 blanks/?'s
	because it has lots of tiny teeth
	it siffs [sifts] through the sand
	they use it to get through the sand
	it esily [easily] sifts threw [through] the water
	its teeth well no?
	because it releases water and sand
	because they have teeth and toow [to] get food
	with small teeth
	because its bill can sift threw [through] sand easily

What is a whale's baleen used for?	7 blanks/?'s
	to filter water
	it is used to drain water like a duck
	draining out the water in his or her mouth
	crushing the food
	catching shrimp
	to filter water
What type of food do birds with short, hard beaks tend to eat?	3 blanks/?'s
	nuts
	clams and oysters
	seeds
	crabs, clams, jellyfish, and squid
	meat
	insex [insects] and little birds
	meat
	insects
	seeds
	seeds, fly's [flies]

What are some causes of erosion?	0 blanks/?'s
	the water and waves
	waves reach up and drags sand down
	strong waves come up and hit the land and takes sand with it
	some are storms
	storms and wind and the ocean
	the corent [current] and big waves
	the wind makes the waves biger [bigger] and it crashs on the dunes and that wipes the sand away
	wind, water, beach veaciles [vehicles]
	rough water
	waves?
	wind, storms and water
	water, wind
	water, wind
How are drift seeds carried onto Nantucket?	12 blanks/?'s {not covered on the tour}
	by rips and currents

What kind of bird feet are best for swimming?	0 blanks/?'s
	webed [webbed] feet
	web feet
	webed [webbed] feet
	webed [webbed] feet or duck feet
	duck feet
	duch [duck] feet. I think
	ducks feet are the best for swiming [swimming]
	webbed feet are best for swimming
	webbed feet
	flat feet like ducks
	webed [webbed] feet
	duck feet
	webbed feet

Why do many birds have claws?	1 ?
	to stay on the trees
	to cary [carry] stuff that they eat
	to carry stuff that they eat
	for holding on to branches
	to lach [latch] on to tree and catch there [their] pray [prey]
	because they live in trees
	so the [they] and [can] grab onto mice and grab onto branches
	so they can hold onto branches
	to cling on trees and branches
	to catch their prey
	to rip there [their] food apart
	so they can hang on to trees

Why does a shorebird need a long pointed beak?	1 ?
	to dig in the sand
	to eat fish
	to eat fish
	to catch fish
	to dig in the sand
	to dig in the dirt
	so it can eat
	so they can dig into the sand and get food
	to get its food out of the ground
	to grab and break clams and shells
	to catch bugs under the sand
	so it can get food in deep sand

Appendix E-12: Boys & Girls Club Prototype End Survey Numerical Data

Note: One child did opt to not participate in the end survey

Circle which grade you are in.						
Grade	**K**	**1**	**2**	**3**	**4**	**5**
Number of Responses	0	2	0	1	2	0

Grade	**6**	**N/A**
Number of Responses	0	0

	1	**2**	**3**	**4**	**5**	**Blank**
How much did you like the erosion book?	0	0	0	0	5	0
How much did you like the bird beak exhibit?	0	0	1	1	3	0
How easy do you think the bird beak exhibit was to use?	0	0	1	0	4	0
How much did you like the bird claw exhibit?	0	0	0	0	4	1
How easy do you think the bird claw exhibit was to use?	0	0	0	1	1	3
How easy was the wording to understand?	3	0	0	1	1	0

	Yes	**No**	**N/A**
Were there too many words?	1	4	0

Appendix E-13: Boys & Girls Club Prototype End Survey Open Ended Question Data

Note: One child did opt to not participate in the end survey

Which exhibits would you like to remain in the Natural Science Museum?	Claw
	I would like a lot of them. Real birds and snakes too.
	BLANK
	BLANK
	BLANK
Are there any topics you would like to see in the museum?	Pumas
	Dinosaur fossils.
	Spiders, scarey things
	Sharks/Snakes
	BLANK
Additional Comments:	BLANK
	Everyone was understandable
	BLANK
	BLANK
	BLANK

Appendix E-14: Boys & Girls Club Investigation Packet Data

Question	B&G Club Answers (6 kids)
How's a duck bill like a comb?	4 blanks
	to push thing out of there way to get food
	tisi pawnty [it is pointy]
What is a whale's baleen used for?	6 blanks {no tour given}
What type of food do birds with short, hard beaks tend to eat?	2 blanks
	ants
	bifrend [different] kinds of nats [nuts] and sebes [seeds]
	seeds
	nuts, seeds and other small seeds
What are some causes of erosion?	0 blanks
	wind, storm
	stowmsp [storms]
	storms and winds
	wind and wader [water]
	wind and sand
	stowmsp [storms]
How are drift seeds carried onto Nantucket?	4 blanks {no tour given}
	water and wayvs [waves]
	Watrr [water

What kind of bird feet are best for swimming?	0 blanks
	webbed and capped [cupped]
	flat
	wedded [webbed]
	buckfeet [duck feet]
	buckfeet [duck feet]
	flat
Why do many birds have claws?	1 blank
	to hang on branches
	pick
	pick up thiings [things]
	to howld [hold] onto trees
	to sit up on tree's [trees]
Why does a shorebird need a long pointed beak?	1 blank
	seeds
	to get foob [food] undr [under] grownd [ground]
	to get there [their] food
	to eat seeds
	to collect insects and other bugs

Appendix E-15: Public School Janet Brannigan's 5th Grade Prototype End Survey Numerical Data

Circle which grade you are in:						
Grade	**K**	**1**	**2**	**3**	**4**	**5**
Number of Responses	0	0	0	0	0	16

Grade	**6**	**N/A**
Number of Responses	0	0

	1	**2**	**3**	**4**	**5**
How much did you like the erosion book?	0	0	6	5	5
How much did you like the bird beak exhibit?	0	0	2	8	6
How easy do you think the bird beak exhibit was to use?	0	0	3	7	6
How much did you like the bird claw exhibit?	0	1	1	8	6
How easy do you think the bird claw exhibit was to use?	0	0	1	5	10
How easy was the wording to understand?	0	0	2	7	7

	Yes	**No**	**N/A**
Were there too many words?	1	15	0

Appendix E-16: Public School Janet Brannigan's 5th Grade Prototype End Survey Open Ended Question Data

Which exhibits would you like to remain in the Natural Science Museum?	The ex[h]ibit with all the animals you can see and feed.
	All of them
	Bird, animal, insect, and currents and stuff.
	BLANK
	I will like to remain the bird exhibit.
	I really like all of them so I would like it if you kept them all.
	I would deffenetly (sic) want the spider exhibit and the snake.
	All of them
	All of them
	The one with the sharks and spider, frogs.
	The bird room, and the rooms the snakes and spiders.
	Animal exhibits, bird exhibits
	I liked all of them so you should put all of every thing in the Natural Science Museum.
	The bird beak exhibit, and the live animals.
	I think then the big bird exhibit was good and the dolphin room and the animal room. I like all of the rooms.
	The bird beak exzibit

Are there any topics you would like to see in the museum?	No
	No
	Sharks!!!!!! And Whales!!!!!!!
	No
	I would love to see dinosaur bones.
	No.
	Yes big snakes and fish.
	?
	?
	Yes I would like to see if there were any sting rays.
	BLANK
	Nantucket history, and solar system.
	The spider ones and the rest of the exhibits.
	The Solar System
	No
	BLANK

Additional Comments:	BLANK
	BLANK
	BLANK
	BLANK
	No
	The collage (sic) students and Ceheryl (sic) did vey well.
	I liked all of it.
	I thought the black widows were cool
	Thought it was very fun.
	BLANK
	I had lots of fun
	BLANK
	I liked when Ceheryl picked up a spider and a everything else.
	No
	No
	BLANK

Appendix E-17: Public School Janet Brannigan's 5th Grade Investigation Packet Data

Question	5th Grade Answers (16 kids)
How's a duck bill like a comb?	3 blanks/?'s
	filter out the water
	to filter out the water
	because of its teeth
	it is like a comb by filtering food
	by filtering
	they have large teeth
	It's like a comb because it can build filters
	duck bills filter things like bacteria and stuff
	it [it's] like a comb because it [its] small teeth
	to filter the water and let it go through
	it's like a comb so it can filter water
	because a ducks bill fillters [filters] things like when we filtered the rocks with the comb
	duck bills filter things like filtering thing[s] out of sand

What is a whale's baleen used for?	5 blanks/?'s
	to catch plankton and not big thing's
	to trap food in its mouth
	whales baleen is used to filter small fish
	whale's baleen is used to filter small fish
	to catch its food
	to catch planton [plankton]
	to catch plankton
	it is used to filter small fish
	for filtering crill [krill] from the water
	to catch its food
	to catch plankton and not big things

What type of food do birds with short, hard beaks tend to eat?	2 blanks
	they eat seeds
	they eat seeds
	they eat like weird food
	things like smaller birds and eggs
	small fish
	small fish and seaweed
	the [they] eat seeds
	sunflower seeds
	sunflower seeds
	seeds
	they tend to eat small seeds
	they tend to eat seeds
	seeds
	they tend to eat sunflower seed's

What are some causes of erosion?	0 blanks
	waves, wind and people
	storm, wind and water
	storms, wind and water
	storms, wind, sea, and the ocean
	human interaction
	by water
	the some causes of erosions are storms, wind and water
	strong wind, storms and waves
	a erosion is when wind blows and the water gets higher
	storms and strong waves and people can do it
	I don't remember
	water, people, currents, wind and storms
	water, wind, people, and rip tides
	climbing up dunes and stormes [storms]
	some causes of erosion are, the ocean and people
	storms and strong winds and strong winds

How are drift seeds carried onto Nantucket?	2 blanks
	by wind pushing them up the Gulf Stream
	they are carried threw [through] the ocean
	they are carred [carried] by the ocean
	by the Gulf Stream
	by the Gulf Stream
	by the Gulf Stream
	they are carried onto Nantucket buy [by] the water
	they are carried by currents like the Gulf Stream
	drift seeds are carried to Nantucket by water
	by the Gulf Streams
	by water
	from the Gulf Stream
	drift seeds are carried to Nantucket by the Gulf Stream
	by the gulf steam [stream]

What kind of bird feet are best for swimming?	0 blanks
	ducks
	the best are webbed
	webbed feet
	webbed feet
	webed [webbed] bird feet
	webbed feet
	ducks foot
	duck feet
	the best kind of bird feet for swimming are webed [webbed] feet
	the duck has wepped [webbed] feet to swimm [swim] fast
	webbed
	webbed feet are the best for swimming
	webbed feet
	webbed feet
	the best kind of feet for swimming is webbed feet
	webbed feet are

Why do many birds have claws?	1 ?
	so they can dig for food
	birds have claws so that they can cling onto branches better
	to claw onto trees
	to live in trees and to grab things
	to hang onto things and get a good grip
	to climb on logs on something and to get there [their] food
	to grab onto branches
	to hang on to branches and trees
	to snatch on branches
	to perch on trees
	so they can grip on the tree branches
	to grip onto trees and branches
	so they can stay on trees
	to cling onto things
	to grasp onto tree branches

Why does a shorebird need a long pointed beak?	5 blanks/?'s
	to get things out of the water and sand etc.
	to grab onto things and to get food
	to get to its food that’s underneath the sand
	to catch fish
	to catch fish
	to get things out of the water and sand to [too]
	to pick up food out of the water and sand
	to get there [their] food and scup [scoop] it up
	to catch fish that are deep
	so that they can dig for worms and insects
	so they can dig it in the sand

Appendix E-18: Public School Kara Carlson's 5th Grade Prototype End Survey Numerical Data

Circle which grade you are in.						
Grade	**K**	**1**	**2**	**3**	**4**	**5**
Number of Responses	0	0	0	0	0	18

Grade	**6**	**N/A**
Number of Responses	0	0

	1	**2**	**3**	**4**	**5**	**N/A**	**Reason**
How much did you like the erosion book?	0	0	5	4	8	1	blank
How much did you like the bird beak exhibit?	0	0	3	7	7	1	blank
How easy do you think the bird beak exhibit was to use?	1	0	7	5	4	1	blank
How much did you like the bird claw exhibit?	0	0	1	6	9	2	blank
How easy do you think the bird claw exhibit was to use?	0	0	8	4	5	1	
How easy was the wording to understand?	1	0	6	2	8	1	

	Yes	**No**	**N/A**	**Reason**
Were there too many words?	1	16	1	blank

Appendix E-19: Public School Kara Carlson's 5th Grade Prototype End Survey Open Ended Question Data

Which exhibits would you like to remain in the Natural Science Museum?	The insect exhibit.
	The bird beak exhibit, bird claw exhibit, the exhibit with all the animals, the bird exhibit
	I would like booth to stay because I think it will help people learn about them
	Tarantula, frog and turtle, rattlesnake, dead birds and bugs, and the telescope.
	I would like to go to the bird exhibits.
	All of them.
	The bird claw exhibit, and bottlenose dolphin room.
	The bird claw one and one about the bird beak.
	The erosion exhibits.
	The bird beakex[h]ibit and the bird claw ex[h]ibit.
	I would the real live exhibit, because it was cool to see w[h]ere each animal lived.
	The erosion, the bird beak, and the claw.
	BLANK
	I would like the erosion book to stay in the Natural Science Museum.
	The erosion book
	The claw exhibit
	The lik [live] animals w[h]ere people can see animals
	I would like to remain is the bird

Are there any topics you would like to see in the museum?	No
	No
	About other cultures I would lick [like] to learn about
	Elephant trunks.
	Yes elephant trunks and lions.
	Yes more skeleton.
	Plants
	I would like to see more ex[h]ibits where there are different things to do.
	Planets.
	Fish, and more interactive ex[h]ibits.
	No
	No.
	BLANK
	More History People exibets (sic)
	BLANK
	No
	A snake ex[h]ibit so that people can learn about snakes
	NO.

Additional Comments:	BLANK
	I learned a lot. And it was fun.
	BLANK
	BLANK
	BLANK
	Awesome!!
	No
	BLANK
	It was awesome!!
	I liked how there were less and less people on each page of the erosion book!
	BLANK
	BLANK
	BLANK
	I think that on the bird exhibit you should use better materials.
	BLANK
	BLANK
	BLANK
	BLANK

Appendix E-20: Public School Kara Carlson's 5th Grade Investigation Packet Data

Question	5th Grade Answers (19 kids)
How's a duck bill like a comb?	4 blanks/?'s
	its like a comb because it can brush stuff
	I don't know
	I don't know how to explain it
	so it can stop stuf [stuff] from moving
	I don't now [know]
	it brushes the sand
	there [their] teeth comb through the water to catch prey
	it has spaces to filter out the water when it's eating
	it is big
	its like a comb because they get their food and not rocks
	because they go through the sand
	it is because they have bng [big] mouths and pointy teeth
	its like a sorter
	a ducks bill is like a comb because it needs to eat the stuff in the water and not the water

What is a whale's baleen used for?	2 blanks
	it is used to get krill
	to catch small fish
	to eat
	it is used for getting fish and letting the water out
	it is used to bring the food they want and leave the food they do not want
	to keep the food in and let the water out
	to take the water out of the mouth and crill [krill] in
	it's used to get crill [krill] from the ocean
	eating krill and plankton
	to eat the crill [krill] and plankton
	a whale baling [baleen] is used for getting fish
	for giting [getting] plangton [plankton] traped [trapped] in there [their] mouth
	it is used for catching food
	it is used for getting food
	the baleen is used to catch crill [krill] into it, then the water flows out
	to sort water from fish

What type of food do birds with short, hard beaks tend to eat?	2 blanks
	seeds and nuts
	sunflower seeds
	they tend to eat sunflower seeds
	seed
	they tend to eat bugs
	bugs
	they eat seeds and nuts. They have a small beak to crack their food open
	small hard food
	I.D.K. [I don't know]
	I don't no [know]
	bugs and insects
	seeds
	seeds
	they tend to eat insects
	things on top of the sand
	rat, weazels [weasels], rabits, and mouse

What are some causes of erosion?	1 blank
	wind, storms, waves, or people
	waves and wind
	some causes are storms, water and wind
	water, air
	wind, storms, waves
	waves, wind, storms, and whater [water]
	wind and rain. Sometimes people
	storms or big waves
	wind and storm
	the causes of erosion is the wind and the storm
	there are people, wind, water
	wind, wauter [water]
	wind, water
	some causes of erosion are storms because of the rain and the wind
	from currents and storms
	boat move fast and cause erosion
	water, currents and the wind

How are drift seeds carried onto Nantucket?	2 blanks
	they are carried through the gulf current
	they are carried by water
	by the ocean
	by the storms
	by water
	the gulf current
	the water
	the ocean
	by the ocane [ocean] and the wind
	driftid [drifted] from tropical island to Nantucket
	by the ocan [ocean]
	because the water
	drift seeds are carried from the current of the ocean
	they are carried on the gulf stream
	from currents and storms

What kind of bird feet are best for swimming?	1 blank
	ducts [ducks]
	webbed
	the best kind is duck feet
	webbed feet
	ducks feet
	the weed [webbed] feet are better for swimming
	duck feet
	webbed feet
	webbed feet
	webbed feet
	the web [webbed] feet
	ducks
	webd [webbed] feet are best for swimming
	webd [webbed] feet are best for swimming
	the webed [webbed] feet are best because its flat
	webbed feet
	wedded [webbed]

Why do many birds have claws?	1 blank
	to help them swim or walk
	to hold onto branches
	to perch on trees and branches
	so that they can grip things or grab food
	to hold on to branches and food
	so they can hang on the trees
	very little
	they need claws to grab food and other things
	to eat there [their] prey
	to grab
	to grab things of [off] the grown [ground] and to protect them silf [themselves]
	so they can sand [stand] on trees and not fall
	so they can stay on branches
	to grab there [their] food
	to grab or catch their dinner
	so they can perch on twigs and trees
	to grib [grab] branchs [branches]

Why does a shorebird need a long pointed beak?	3 blanks/?'s
	to help them grab things
	to eat food
	to get the rocks and things in the sand
	to take the food
	to get their food
	to catch fish
	to reach into the sand for food
	to dive into water, maybe
	to dive into water
	so it can pick up stuf [stuff] of [off] the ground lick [like] bugs
	so they can stick there [their] long beak into the ground to get worms
	to dive in the water
	so they can brush the sand to find rocks
	so they can dig deep to get food
	to catch fish

Appendix F: Observation Sheets

Appendix F-1: Open House Observation Sheets

Maria Mitchell Section of Large Room

- Telescope and old tools case
    - Glanced at
    - Read exhibit labels
    - Ignored
    - Pointed at
    - Asked questions about

- Left glass case
    - Glanced at
    - Read exhibit labels
    - Ignored
    - Pointed at
    - Asked questions about

- Maria Mitchell pictures and wall text
    - Glanced at
    - Read exhibit labels
    - Ignored
    - Asked questions about

- Right glass case
    - Glanced at
    - Read exhibit labels
    - Ignored
    - Pointed at
    - Asked questions about

- Display shelves with touchable items
    - Glanced at
    - Read exhibit labels
    - Ignored
    - Touched
    - Manipulated
    - Asked questions about

General Ecology Room

- Skull case
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Butterfly panel
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Asked questions about

- Raptor case
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Geologic maps
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Asked questions about

- Tick and Lyme Disease panel
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Asked questions about

- Research Table
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Touched
  - Asked questions about

- Flora Matching Exhibit
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Touched
  - Asked questions about
  - Manipulated

- Small Mammals of Nantucket
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Collections Display
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Owl Pellet Table
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Touched
  - Asked questions about

Connector 1

- Insects of Nantucket case
    - Glanced at
    - Read exhibit labels
    - Ignored
    - Pointed at
    - Asked questions about
- Extinct Insects panel
    - Glanced at
    - Read exhibit labels
    - Ignored
    - Asked questions about
- Topographical Map
    - Glanced at
    - Read exhibit labels
    - Ignored
    - Touched
    - Asked questions about

Bird Room

- Large Bird Cabinet
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Duck Cabinet
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Evolution Design Box
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Nest Table
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Congdon Collection
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Endangered Case
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Piping Plover Display
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Bird Matching exhibit
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Touched
  - Asked questions about
  - Manipulated

- Migration Birds Case
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Birds of a Feather panel
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Asked questions about

- Bird Posters
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Asked questions about

Hallway A

- Algae exhibit
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about
- Changes in the land maps and images
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about
- Then and Now pictures
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

Marine Room

- Glass Cabinet in front of fireplace
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Shell matching display
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Touched
  - Asked questions about
  - Manipulated

- Dolphin Skeleton
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Ocean Current 3-D Map
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Big Bones
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Touched
  - Asked questions about

- Sponge Cabinet
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Sea Birds Cabinet
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Seeds Cabinet
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Shell Cabinets
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

- Wall Map and pictures
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Asked questions about

Connector 2

- Whale poster
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about

Live Animal Room

We are not conducting observations on this room since it is currently not an accurate representation of what is in the museum during the summer season.

- Preserved animal cabinet
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about
- Animal cages
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Touched
  - Asked questions about

Hallway B

- On going Research case (preserving wild Nantucket and the American Burring Beetle)
    - Glanced at
    - Read exhibit labels
    - Ignored
    - Pointed at
    - Asked questions about

Appendix F-2: Prototype Observation Sheet

The MMA Group Prototype Observation Sheet

General Ecology Room

- Erosion Story Book
    - Glanced at
    - Read exhibit labels
    - Ignored
    - Pointed at
    - Asked questions about
    - Explained
    - Manipulated

Bird Room

- Bird Beak Adaptations
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about
  - Explained
  - Manipulated
- Bird Feet Adaptations
  - Glanced at
  - Read exhibit labels
  - Ignored
  - Pointed at
  - Asked questions about
  - Explained
  - Manipulated

Appendix G: Observation Raw Data

Appendix G-1: Open House Observation Data

	Telescope and Old Tools Case	Left Glass Case	Maria Mitchell Pictures and Wall Text	Right Glass Case	Display Shelves with Touchable Items	Skull Case	Raptor Case	Research Table	Small Mammals of Nantucket	Butterfly Panel	Geologic Maps	Tick and Lyme Disease Panel	Flora Matching Exhibit	Collections Display	Insects of Nantucket Case	Extinct Insects Panel	Topographical Map
Glanced At	4	0	2	3	5	5	10	0	13	4	0	3	9	13	6	0	0
Read Exhibit Labels	0	0	2	3	2	0	3	0	2	1	0	1	3	1	2	0	0
Ignored	12	16	14	13	11	11	6	14	3	12	16	13	7	3	10	16	16
Pointed At	1	0	0	0	4	0	0	0	5	0	0	0	0	4	5	0	0
Asked Questions About	1	0	0	0	2	0	1	0	4	0	0	1	1	3	2	0	0
Touched	NA	NA	NA	NA	2	NA	NA	NA	NA	NA	NA	NA	5	NA	NA	NA	NA
Manipulated	NA	NA	NA	NA	2	NA	NA	NA	NA	NA	NA	NA	5	NA	NA	NA	NA

	Large Bird Cabinet	Duck Cabinet	Evolution Design Box	Nest Table	Congdon Collection	Endangered Case	Piping Plover Display	Bird Matching Exhibit	Migration Birds Case	Birds of a Feather Panel	Bird Posters	Algae Exhibit	Changes in the Land Maps and Images	Then and Now Pictures	Glass Cabinet in Front of Fireplace	Shell Matching Display	Dolphin Skeleton	Ocean Current 3-D Map	Big Bones	Sponges Cabinet	Sea Birds Cabinet	Seeds Cabinet	Shell Cabinets	Wall Map and Pictures	Whale Poster	Ongoing Research
Glanced At	5	4	3	5	2	2	1	3	7	0	0	2	4	3	3	13	6	6	10	4	0	1	11	5	5	7
Read Exhibit Labels	4	1	3	6	5	2	0	0	0	0	0	0	0	1	2	0	1	3	1	1	0	2	4	0	1	5
Ignored	11	12	13	11	14	14	16	13	9	16	16	14	12	12	13	3	10	10	6	12	16	15	5	11	11	9
Pointed At	2	1	1	2	4	2	0	0	2	0	0	0	0	0	0	0	1	6	0	0	0	0	4	0	1	3
Asked Questions About	1	0	0	3	5	1	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0	1
Touched	NA	NA	NA	NA	NA	NA	NA	4	NA	NA	NA	NA	NA	NA	NA	13	NA	NA	10	NA	NA	NA	NA	NA	NA	NA
Manipulated	NA	NA	NA	NA	NA	NA	NA	9	NA	NA	NA	NA	NA	NA	NA	13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Appendix G-2: Lighthouse School Prototype Observation Data

	Kindergarten	First & Second	Third, Fourth & Fifth
Erosion Story Book			
Glanced at	20	9	15
Read exhibit labels	0	0	7
Ignored	0	0	0
Pointed at	0	0	0
Asked questions about	0	0	5
Explained	0	0	6
Manipulated	0	0	7 read
Bird Beak Adaptation			
Glanced at	7	9	9
Read exhibit labels	0	1	6
Ignored	0	0	0
Pointed at	0	0	0
Asked questions about	0	0	2
Explained	0	0	0
Manipulated	2	9	15

Bird Feet Adaptation			
Glanced at	20	9	15
Read exhibit labels	20	9	15
Ignored	0	0	0
Pointed at	20	9	15
Asked questions about	5	2	3
Explained	0	5	12
Manipulated	20	9	15

Appendix G-3: Lighthouse School Prototype Written Observations and Notes

Kindergarten	
General	More visual because they can't read
Beaks	Nail sharper than finger
	Pliers can be pushed down to bottom?
	Can't read
Feet	Tape doesn't' really like water
	Smaller stick for perch?
	Teacher: Oh, that's so pretty
Erosion Book	Read to kids
	"I want to be red"
	Noticed people missing

First & Second	
General	Scavenger hunt to look for something specific
	Suggestion: remove doors? Makes more open
Teacher	Should be able to touch shells/rocks
	Traveling kit w/ raptors (fifferent feathers) and whales (baleens/teeth)
	Children overstimulated
	Able to relate to actual lives (Madaket)
	Be able to touch and feel
	Stuff to bring to class
	Diff feathers

Erosion	Lighthouse
	Too much death
	Knew what erosion was
	Knew wind and big waves
	Noticed people fell off by page 6
	"I wish the lighthouse fell into the ocean"
	Make it a Sankaty Head light
Beaks	Get picture to go with our experiment?
	Able to ID tweezers as beak for sand piper
	Nail better
	Something better than comb?
	Do you know ducks have features like whales?
	Still rely on tour "guide" to read label for groups
Feet	Label made no sense
	Understood adaptations
	Focused learning
	Child read exhibit
	Able to ID which foot works best in H2O
	Still rely on tour "guide" to read labels for groups
	More touchable things related to topic

Third, Fourth & Fifth	
General	Receptive to questions
Beaks	Goal to the sandpiper exhibit
	That pliers are for larger rocks
Feet	"Out of reach" gets kids confused
Erosion Book	Comparison to Codfish Park
	Can read!!
	Notice shape change in cliffs
	People disappearing
	Asked questions about getting beach back

Appendix G-4: Mike Girvin Prototype Observation Data

Erosion Story Book	16	
Glanced at	16	Read to class
Read exhibit labels	0	
Ignored	4	
Pointed at	4	
Asked questions about	8	
Explained	0	Read to class
Manipulated		
Bird Beak Adaptation		
Glanced at	16	
Read exhibit labels	16	
Ignored	0	
Pointed at	0	
Asked questions about	5	
Explained	0	
Manipulated	15	
Bird Feet Adaptation		
Glanced at	16	
Read exhibit labels	6	
Ignored	0	
Pointed at	2	
Asked questions about	3	
Explained	4	
Manipulated	14	

Appendix G-5: Mike Girvin Prototype Written Observations and Notes

General	Interacting a lot more
Beaks	Screwdriver seemed to promote destruction of log
	Destructive
	Second group didn't read labels except for four
Feet	Tried to peel bark off
Erosion Book	Recognized people gone
	Did not call people
	Change to Sconset

Appendix G-6: New School Prototype Observation Data

Erosion Story Book	
Glanced at	13
Read exhibit labels	none
Ignored	0
Pointed at	?
Asked questions about	2
Explained	5
Manipulated	read to
Bird Beak Adaptation	
Glanced at	13
Read exhibit labels	4
Ignored	0
Pointed at	0
Asked questions about	0
Explained	0
Manipulated	13
Bird Feet Adaptation	
Glanced at	13
Read exhibit labels	10
Ignored	0
Pointed at	13
Asked questions about	4
Explained	5
Manipulated	10

Appendix G-7: New School Prototype Written Observations and Notes

General	Kids excited wanted to see museum right away
	Had some trouble reading
	Had to encourage kids to read label
Beaks	Four glanced at beaks before Cheryl started talking
	Know adaptation: 2 kids
	Kids tried to break already broken seeds
	Change container
	Close together-- need to spread out more
	Tether tools to exhibit!
	Add text mentioning rocks at bottom of shorebird bin
	Mixed up tools
	Questionable understanding of seed exhibit
Feet	Where do they live? Mention habitat.
	Ask questions about habitats.
	Know adaptation: 1 kid
	Make connections.
Erosion Book	hands raised : 3 kids
	Answered ?s : 8 kids
	Blue's gone noticed
	Knew bigger waves (storm)
	Answered last ? : 4 kids

Appendix G-8: Boys & Girls Club Prototype Observation Data

Erosion Story Book	
Glanced at	6
Read exhibit labels	3
Ignored	0
Pointed at	3
Asked questions about	4
Explained	2
Manipulated	0
Bird Beak Adaptation	
Glanced at	6
Read exhibit labels	3
Ignored	0
Pointed at	0
Asked questions about	0
Explained	4
Manipulated	6
Bird Feet Adaptation	
Glanced at	6
Read exhibit labels	3
Ignored	0
Pointed at	0
Asked questions about	2
Explained	2
Manipulated	6

Appendix G-9: Boys & Girls Club Prototype Written Observations and Notes

General	no understanding of adaptation
	very shy
Beaks	BLANK
Feet	Change text to webbed rather than duck?
	Material difference --> deductive reasoning
	Short hard beak vs long thin beaks = older kid question b/c of type of comparison
Erosion Book	Too many questions for little children?

Appendix G-10: Janet Brannigan's 5th Grade Prototype Observation Data

Erosion Story Book	
Glanced at	16
Read exhibit labels	
Ignored	
Pointed at	
Asked questions about	5
Explained	9
Manipulated	
Bird Beak Adaptation	
Glanced at	16
Read exhibit labels	10
Ignored	0
Pointed at	2
Asked questions about	2
Explained	3
Manipulated	16
Bird Feet Adaptation	
Glanced at	16
Read exhibit labels	10
Ignored	2
Pointed at	8
Asked questions about	5
Explained	9
Manipulated	11

Appendix G-11: Janet Brannigan's 5th Grade Prototype Written Observations and Notes

General	More cooperative
	Eager to learn
Beaks	Some don't want to read
	Encouraged to read by teacher
	knew adaptation: 0
	Related to Kung Fu Panda?!
Feet	Two girls sat in corner, didn't interact/manipulate
	Second group usually more restless than first
	Children already get it
	Two people pointed out only perching birds, not birds of prey
	knew adaptation: 2
	One girl started reading label as soon as she entered the room, very interested
Erosion Book	Knew erosion
	Noticed falling off on first page
	"Oh, the people fell off!"
	"It's good visually" -Janet Brannigan
	4 answered ?'s

Appendix G-12: Kara Carlson's 5th Grade Prototype Observation Data

Erosion Story Book	
Glanced at	18
Read exhibit labels	7
Ignored	0
Pointed at	3
Asked questions about	6
Explained	14
Manipulated	
Bird Beak Adaptation	
Glanced at	17
Read exhibit labels	10
Ignored	
Pointed at	1
Asked questions about	1
Explained	4
Manipulated	17
Bird Claw/Feet Adaptation	
Glanced at	18
Read exhibit labels	8
Ignored	1
Pointed at	5
Asked questions about	
Explained	2
Manipulated	14

Appendix G-13: Kara Carlson's 5th Grade Prototype Written Observations and Notes

General	Very crowded --> hard to manage groups
Beaks	knew adaptation: 4 kids
	excited about what learned w/ beaks and nuts
	mixed up
	not at bottom
Feet	Might need better labels --> Adaptations, feet connected to habitats
	First group didn't read labels
	Second group participated learned
	Most manipulated
	First group: 4 didn't manipulate & 4 read
Erosion Book	"Sometimes beaches get bigger. Where does the sand go?"
	2 raised hands
	how they live?
	how they change
	5 __ out E?
	notice people gone when only 2 left

Appendix H: Prototype Labels

Appendix H-1: Prototype Labels Version 1

Webbed feet are an adaptation to allow ducks to move on the water faster. This is due to the increased amount of surface area a webbed foot has compared to the typical 4 “toed” feet of other birds, like hawks. The 4 “toed” feet of most birds allow them to perch on tree branches out of the reach of ground predators. Birds of prey also use the talons on the end of their toes are also used to tear at their food.

Feel the difference. The wider spatula pushes more water than the smaller, curved staple remover. Which do you think represents the duck’s webbed feet? Why?

Birds have adapted the shape and size of their beaks to help get their food. The sand piper has a long narrow beak so it can reach down deep into the sand to get at their food.

Can you see how the different beak lengths allow the shorebird to reach deeper into the sand?

A woodpecker has a narrow beak but it is short and hard, so it can get at bugs under the bark of trees.

Feel the difference for yourself. Try knocking the nail against the log and then use the tip of your finger. Which do you think would work better at getting under the bark?

Duck beaks are big and flat with little teeth-like filters called ***lamellae***. Ducks scoop water into their mouths and filter it out the sides of their beaks and the lamellae keep the food in while letting the water out.

Can you filter the rocks out of the sand like ducks filter their food?

Do you know how the beach changes shape?

Erosion causes the beach to shrink in size.
Waves weaken the cliffs and cause pieces
to fall to the beach below.

The waves crashing against the shore and
cliffs carry sand off the beach into the ocean,
making the beach smaller.

The powerful currents around Nantucket
also take away sand from the beach.
Erosion is always happening.
How do you think a storm affects erosion?

Strong storms cause erosion to occur faster.
The big waves carry larger amounts
of sand away from the cliffs and beach.

Strong wind also helps erosion.
The loose sand is carried away in the breeze.

Soon the cliffs and beach are much smaller,
the sand is spread through the ocean.

Appendix H-2: Prototype Labels Version 2

Webbed feet are an adaptation to allow ducks to move on the water faster. This is due to the increased amount of surface area a webbed foot has compared to the typical 4 “toed” feet of other birds, like hawks.

Feel the difference. The wider spatula pushes more water than the smaller, curved staple remover. Which do you think represents the duck’s webbed feet? Why?

The 4 “toed” feet of most birds allow them to perch on tree branches. This keeps them safely out of the reach of ground predators. Some birds also have talons at the end of their toes which can be used to tear at food.

Try using the staple remover like a bird foot and grip the branch. Then try using the spatula. Which works better?

Birds have adapted the shape and size of their beaks to help get their food. The sand piper has a long narrow beak so it can reach down deep into the sand to get at their food.

Can you see how the different beak lengths allow the shorebird to reach deeper into the sand?

A woodpecker eats bugs that are found under the bark of trees. It has adapted a hard narrow beak so that it can get to the bugs.

Try knocking the screw driver against the log and then use the tip of your finger. Which do you think would work better at getting under the bark? Why?

Did you know that **ducks** have physical features like **whales?**

Duck beaks are big and flat with little teeth-like filters called ***lamellae***. Ducks scoop water into their mouths and filter it out the sides of their beaks and the lamellae keep the food in while letting the water out.

Can you filter the rocks out of the sand like ducks filter their food?

Do you know how the beach changes shape?

Erosion causes the beach to shrink in size. Waves weaken the cliffs and cause pieces to fall to the beach below.
The new slope that forms has a special angle called the angle of repose. This is the steepest angle that the slope can have and still be stable.

Waves crashing against the shore and cliffs carry sand off the beach into the ocean, making the beach smaller. Can you think of a place where erosion is occurring on Nantucket?

The powerful currents around Nantucket carry sand away from the beach to other places. Where do you think the sand from Siasconset it being taken to?

Erosion is always happening.
How do you think a storm affects erosion?

Strong storms cause erosion to occur faster. The big waves carry larger amounts of sand away from the cliffs and beach.

Strong winds also increase erosion.

The loose sand is carried away in the breeze.

Soon the cliffs and beach are much smaller,
the sand is spread through the ocean. Do you
think there is any way that we can prevent erosion?

Appendix H-3: Prototype Labels Version 3

Birds that tend to eat seeds and nuts have short, hard beaks. Their beaks have adapted to allow the bird to crack the shells. Birds with long narrow beaks tend to eat insects.

See for yourself; is it easier to break the sun flower seed with the short, hard pliers or the long, thin tweezers?

Birds have adapted the shape and size of their beaks to help get their food. The sand piper has a long narrow beak so it can reach down deep into the sand to get at their food.

Try using the short and long beaks to find the rocks hidden in the sand. Can you see how the different beak lengths allow the shorebird to reach deeper into the sand for food?

The powerful currents around Nantucket carry sand away from the beach to other places. Where do you think the sand from 'Sconset it being taken to?

Soon the cliffs and beach are much smaller, the sand is spread through the ocean. Can you think of other things that change the shape or size of the beach?

Appendix H-4: Prototype Labels Version 4

Webbed feet are an adaptation to allow ducks to move on the water faster. This is due to the increased amount of surface area a webbed foot has compared to the typical 4 toed feet of other birds, like hawks.

Feel the difference. Which tool do you think represents the duck's webbed feet? Why?

The 4 toed feet of most birds allow them to perch on tree branches. This keeps them safely out of the reach of ground predators. Some birds also have talons at the end of their toes which can be used to tear at food.

Try using the staple remover like a bird foot and grip around the branch. Then try using the spatula. Which works better?

Birds have adapted the shape and size of their beaks to help get their food. The sand piper has a long narrow beak so it can reach deep down into the sand to reach worms, insects, shrimp and other food found there.

Try using the short and long beaks to find the rocks hidden in the sand. Can you see how the different beak lengths allow the shorebird to reach deeper into the sand for food?

Small birds that tend to eat seeds and nuts have short, hard beaks. Their beaks have adapted to allow the bird to crack the shells. Birds with long narrow beaks tend to eat insects.

See for yourself; is it easier to break the sun flower seed with the short, hard pliers or the long, thin tweezers?

Duck beaks are big and flat with little teeth-like filters called ***lamellae***. Ducks scoop water into their mouths and filter it out the sides of their beaks. The lamellae keep the food in while letting the water out much like a whale's baleen.

Can you filter the rocks out of the sand like ducks filter their food out of the water?

The powerful currents around Nantucket carry sand away from the beach to other places. Which places do you think the sand is being taken to?

Appendix H-5: Prototype Labels Final Version

The 4 toed feet of most birds allow them to perch on tree branches. This keeps them safely out of the reach of ground predators.

Try using the staple remover like a bird foot and grip around the branch. Then try using the spatula. Which works better?

Appendix I: MMA Tour Description

Note: Provided to us by Andrew McKenna-Foster

MMA Museum Tours; A basic outline

These tours are what we use to unite all the individual exhibits under a comprehensive theme. Tentatively, the theme is:

"Nantucket has unique and rare habitats that anyone can explore and enjoy thanks to the foresight of the island's historical amateur naturalists and the dedication of today's conservation groups. The MMA Natural Science Museum aims to help visitors carry on this naturalist legacy by encouraging their curiosity in the natural world and providing a springboard for them into the ecosystems of Nantucket Island."

Our goal is to inspire visitors to explore Nantucket's natural history on their own, enjoy the huge acreage of conservation land, and pass on their enthusiasm to others. Also, we'd like them to visit MMA's other facilities.

The tour takes about 15-30 minutes depending on how attentive the group is. Tour size usually ranges from 1 to 10. It's usually about 3-5 people.

On any given tour you will tailor this information for the group. As long as you get the facts right and provide useful and understandable information, you can leave things out or add things you are interested in.

Start at the entrance to the General Ecology Room.

- Maria Mitchell lived from 1818-1889
- She was third of ten children in a Quaker family and her father worked many different jobs to support all his kids: Cooper, teacher, astronomer, surveyor, bank cashier etc.
- Maria had a natural talent for math and astronomy and began working with him on astronomy calculations before she was a teenager. By age 14 she had learned all mathematics her father could teach her.
- Case with telescope, chronometer and octant- These instruments are similar to what Maria and her father worked with.
    - Octant: Measure latitude, similar to a sextant but with a smaller scale
    - 19th century Telescope. In the 1800's, telescopes were pricey items. The Coast Guard long-term loaned the Mitchells a telescope for survey work.
    - Chronometer: Clock for ships. Ship navigators depended on it to keep accurate time for longitude calculations.
- Maria rated her first chronometer when she was 14. A very large responsibility.
- Maria's work with her father continued and she began teaching at a public school when she was 16 (opened her own school when 17) and became the first librarian of the Nantucket Atheneum (the library) when she was 18.

- The family moved to the second floor of the bank at the top of Main Street in 1836 and her father worked as the bank's cashier (it was a little different than today – more responsibilities). Maria and her father built an observatory on the roof and here, in 1847, she became the first American woman to discover a comet through a telescope.
- At the time the king of Denmark was offering gold medals to those who discovered comets using a telescope. With help from her father and his many connections in the astronomy community, Maria was eventually awarded the medal – first American and first woman to receive the honor.
- She became famous in the scientific world and traveled through Europe and eventually became the first woman professor of astronomy at Vassar. She became the first female professional astronomer in the U.S. when she was hired to calculate orbits of Venus for the US Nautcial Almanac. (also first woman to work for US Federal Government. She was also
    - First woman inducted into the American Academy of Arts and Sciences
    - First woman inducted into the American Association for the Advancement of Science
    - One of first females inducted into American Philosophical Society

    <u>All of this with no formal education</u>. However, Maria did receive several honorary degrees in her life.

- Her students at Vassar loved her and she was a very engaging and witty professor. She preferred teaching by example and teaching through research rather than giving long lectures.
- Literature Display- Point out the current literature on display
- Suggest that the best way to learn more is go on a tour of Maria's house across the street.

General Ecology Room (move into room and let people spread out)

- Maria preferred hands-on learning as opposed to lectures and this museum is designed with this idea in mind. I'm going to take you through each room and describe Nantucket's ecology and natural history but it's up to you to flex your curiosity and go back through to learn more and investigate the displays more thoroughly. Nantucket's natural world is crammed into this little building and you'll find things you never knew existed if you take your time. During the tour, ask any question at any time.
- Nantucket Island is approx. 3 miles wide and 12 miles long. It's a big pile of sand left over from the last glacial period. The ocean and wind play a huge part in not only shaping the island physically, but also in shaping the plant communities which, in turn, shape the animal communities. Many of the plants here are adapted to wind and salt spray.
    - Bayberry is one example (pass around leaves). Leathery leaves. A very fragrant plant. The berries were boiled to extract the fragrant wax to scent the smelly animal fat candles.

- Nantucket is a great place for berry picking- blueberries, huckleberries and cranberries are abundant and all native. These all have leathery leaves as well.
- Wntergreen is also abundant (pass around leaf)

- These plants all live in a habitat called sandplain grassland and coastal heathland. Another species greatly enjoys this habitat too. Us humans. Evidence of this is seen in the great number of houses humans build along the northeastern coast. All this building has made the habitat exceedingly rare and it's estimated that 80% of the world's supply is on Nantucket, Tuckernuck, and Martha's Vineyard.
- Fortunately, Nantucketers have had great foresight and between several conservation organizations, over half of the island's area is conserved land. Show NCF Map**.** The bike trails are an excellent way to access this land for hiking and picnicking. Nantucket has great beaches but the interior is just as beautiful.
- One thing that Nantucket shares with the mainland is the invasive species problem. (You can put people on the spot and ask them what makes a species invasive) An invasive species is a species that is not native and has a detrimental impact on its new environment. Purple Loostrife takes over wetlands and not only out-competes other plants but it doesn't provide food for the native animals and they are forced to find a new home. (Show Plant Electronic Field Guide)
- Nantucket supports 1,265 flowering plants, 302 species of birds, 20 mammal species, thousands of insect species, and the waters are teaming with fish.
  - Other things to mention: Deer, absence of raccoons, presence of crayfish, bogs, etc.
- Suggest that after the tour people come back and dissect an owl pellet and build a mouse skeleton, take the plant quiz, and learn more about everyone's favorite arachnid, the Lyme disease bearing tick.
- Herd everyone through the short hallway. Use cattle prod (provided) if necessary. (haha)

Short Hallway

- Notice some endangered insects and butterflies as well as some of the larger moth species.
- Move into Bird room

Bird Room

- Nantucket is a great place for birding. Occasionally rare species are blown into the area. In 2004 a red footed falcon from Africa landed on Martha's Vineyard and this past April, 2008, a Pacific Loon was spotted for the first time ever.
- Migrating birds stop on Nantucket on their way south for the winter. The island collects birds from a 15 mi radius during migration periods. Some

birds pass through, and some, like the Long-tailed duck (point out stuffed bird), stay for the winter in enormous numbers- over 500,000.

- Nantucket is home to ~13 nesting pairs of Osprey and you can see the human made nest poles around the island. Twenty to thirty years ago, ospreys were dying in huge numbers, possibly from DDT, but their population is now increasing thanks to conservation efforts.
- (Mention MMA bird walks)
- A good transition to the dolphin room- While some come to Nantucket for the bird and tick fauna, most come for the beaches and marine life (and shopping). Move into Dolphin room.

The Dolphin Room

- (Gather round relief map) Nantucket has about 50 miles of shoreline and it is all beaches. It's just one huge pile of sand and the nearest bedrock is 1,200 feet below.
- 20,000 years ago, the edge of a glacier stopped where the island is now. As ice moved from the far north it carried tons of rocks and gravel and dumped them all at this southern tip creating a big pile (called a terminal moraine). At that time the ocean level was several hundred feet lower that it is today and the coast was about 35 miles to the south. At some points it was 100 miles away. 12,000 years ago the glacier began to recede and as it did, torrents of water coursed south to the sea. The rivers dispersed the sand from the moraine into an outwash plain and cut channels into it. The south side of the island is what remains of this outwash plain and the parallel valleys and lakes are the old river beds. The glacier left behind large boulders, called glacial erratics- look for them while hiking in the Middle Moors. Large chunks of ice were buried beneath sediment and when they later melted, they left behind kettle bogs.
- Can talk about Native Americans here.
- Today, the ocean currents are shaping the island moving sand from the south to the north. During large winter storms, up to 40ft of beach has been lost in Siasconset (usually pronounced Sconset). In April 2007, a house fell off a small bluff onto the beach due to heavy waves eroding its foundation.
- Nantucket is surrounded by sandy shoals which provide great beaching areas for grey seals. The shallow water also provides perfect habitat for eel grass beds which, in turn, are used by virtually all the local sea life as nurseries and hunting grounds.
- Eel grass supports Nantucket's scallop population. The scallop fishery here is the last commercial bay scallop fishery left on the east coast.
- Most of the display items in this room were found on Nantucket beaches. Tell people to keep their eyes open and they may stumble upon a whale rib or a massive turtle shell.
- (Mention the Marine walks and Beach combing walks at the aquarium.)

- Other things to talk about: Anatomy of a whale skull, dolphin's vestigial pelvic bones, ocean currents and seeds, etc.
- Move into the animal room.

Live Animal Room:

- We have live snakes, turtles, invertebrates etc.
- There are 6 species of snake on the island
  - Milk, Garter, Ribbon, Water, Ring-neck, and Green. The green snake is extremely rare but still survives on Cotue.
- There are three turtle species
  - Snapping turtles- Eat anything including, fish, insects, plants and other turtles. Notice the small plastron, it can lift itself completely off the ground. Can be aggressive, can't withdraw into its shell. Can live over 40 yrs and be 1.5 ft. long. Can estimate age by counting rings on shell plates.
  - Painted turtle- Very common and colorful. Eats algae, duckweed and small invertebrates. Can live over 20 years.
  - Spotted turtle. The turtle is rare and lives in wet bog and shallow pond habitats. It is commonly collected as a pet and its numbers are thought to be threatened by that practice. Can live over 30 years.

- There are at least 10 species of fresh water fish. Point out fish species.
- Answer the plethora of questions.
- Other things to talk about
  - Hands-on bone identification
  - The outdoor pond
  - Spade Foot Toad
  - Spiders
  - Anything you want to expound upon and harangue your tour with.

Appendix J: Informed Consent Form

The University of
Science and Technology.
And Life.™

Informed Consent Agreement for Participation in a Research Study

Investigators: Molly Congdon, Alex Tutone, and Victoria Valencia

Contact Information: Maria Mitchell Association
4 Vestal Street
Nantucket, MA 02554
Email: mariamitchell@wpi.edu

Title of Research Study: Updating the Natural Science Exhibits at the Maria Mitchell Association

Sponsor: The Maria Mitchell Association

Introduction:
You are being asked to participate in an observational and feedback study. Before you agree, however, you must be fully informed about the purpose of the study, the procedures to be followed, and any benefits, risks or discomfort that you may experience as a result of your participation. This form presents information about the study so that you may make a fully informed decision regarding your participation.

Purpose of the study:
Through visitor observation and feedback forms, we will be investigating the ways in which children interact with the exhibits and/or prototypes in the Natural Science Museum of the Maria Mitchell Association. This information will be used to develop recommendation for the MMA on how they should update and improve their Natural Science exhibits.

Procedures to be followed:
During visits to the MMA children will be observed interacting with the exhibits. Parents/ guardians must sign a consent form before entering the exhibits allowing the children to be observed. Parents and children will be asked to fill out a feedback form about the Natural Science Museum at the end of their visit. You do not need to participate in the survey or answer every question. A writing utensil and space to complete the survey will be provided. Once you are finished you can turn the survey in to an MMA staff member.

Risks to study participants:
There is no risk to you in being observed or answering the survey. All information that you provide is confidential.

Benefits to research participants and others:
There is no direct, immediate benefit to you; however, you will provide us with information to improve the MMA's natural science exhibits.

Record keeping and confidentiality:
Personal information beyond educational level is not required. As a result not identifying information may be used against you at any time. All records associated with this study will be held confidential so far as permitted by law. However, the study investigators, the sponsor or its designee and, under certain circumstances, the Worcester Polytechnic Institute Institutional Review Board (WPI IRB) will be able to inspect and have access to data related to the study. Any publication or presentation of the data will not identify you.

Compensation or treatment in the event of injury:
We do not anticipate any injury to occur during your visit to the museum as a result of your participation in this survey. No compensation for medical care can be provided by WPI. You do not give up any of your legal rights by signing this statement.

Cost/Payment:
There is no cost to you for completing the survey and you will receive a free visit to the MMA Natural Science Museum where we will observe you.

For more information about this research or about the rights of research participants, or in case of research-related injury, contact:
Molly Congdon, Alex Tutone, and Victoria Valencia at the Maria Mitchell Association, 4 Vestal Street, Nantucket, MA 02554, Email: mariamitchell@wpi.edu. You may also contact the chair of the WPI Institutional Review Board (Prof. Kent Rissmiller, Tel. 508-831-5019, Email: kjr@wpi.edu) or WPI's University Compliance Officer (Michael J. Curley, Tel. 508-831-6919).

Your participation in this research is voluntary.
Your refusal to participate will not result in any penalty or loss of entitlements to you. You may decide to stop participating in the survey at any time without penalty or loss of other benefits. The project investigators retain the right to cancel or postpone the experimental procedures at any time. Data obtained in this study will become the property of the investigators and WPI. If you withdraw from the study, data already collected from you will remain in the study.

By signing below, you acknowledge that you have been informed about and consent to be a participant or allow your child to be a participant in the study described above. Make sure that your questions are answered to your satisfaction before signing. You are entitled to retain a copy of this consent agreement.

____________________________ Date: ____________________
Study Participant/ Parent Signature

Study Participant/ Parent Name (Please print)

Signature of Person who explained this study

Date:

Appendix K: Massachusetts State Educational Curriculum Frameworks

Appendix K-1: Earth and Space Science Frameworks

MA K-8 Frameworks

Earth and Space Science

Pre-K to 2

	Learning Standard	IDEAS FOR DEVELOPING INVESTIGATIONS AND LEARNING EXPERIENCES	SUGGESTED EXTENSIONS TO LEARNING IN TECHNOLOGY/ENGINEERING
		Earth's Materials	
1	Recognize that water, rocks, soil, and living organisms are found on the earth's surface.	Walk around the playground observing and discussing where water, rocks, soil, and living organisms are found.	Identify characteristics shared by naturally occurring rocks and manmade concrete. (T/E 1.1)
		Periodic Phenomena	
5	Identify some events around us that have repeating patterns, including the seasons of the year, day and night.	Make a list of things seen outdoors and in the sky during the day. Make another list of things seen outdoors and in the sky at night. Discuss the differences between the day and night lists.	Use a thermometer to record the temperature from morning to noon over several weeks and discuss any patterns that emerge. (T/E 2.1)
		Grades 3 to 5	
		Rocks and Their Properties	
1	Give a simple explanation of what a mineral is and some examples, e.g., quartz, mica.	Observe and describe the characteristics of ore minerals such as magnetite and hematite (two sources of iron).	Design a flowchart to demonstrate how silica from sand is used to make glass. (T/E 2.2)
		Soil	
4	Explain and give examples of the ways in which soil is formed (the weathering of rock by water and wind and from the decomposition of plant and animal remains).	Observe sand with a hand lens. Note how particles resemble minerals. Observe topsoil with a hand lens. Look for fragments of organisms. Note differences in color, texture, odor, and clumping due to organic components vs. pure sand. Mix topsoil and sand together in various proportions to represent samples of types of	Design and construct a composting bin being sure to keep design considerations in mind, e.g., aeration, resistance to rot, etc. (T/E 1.2, 2.1–2.3)

		soils.	
		Weather	
8	Describe how global patterns such as the jet stream and water currents influence local weather in measurable terms such as temperature, wind direction and speed, and precipitation.	Design an activity to illustrate convection (essential in transferring both heat and moisture around the world; drives both wind circulation and ocean currents.) Freeze a dark solution of food coloring and water in an ice cube tray. Float a colored ice cube on water in a transparent container. Discuss what happens, and how it is connected to convection in both liquid and gas.	Make a model of an ocean current. Fill a jar halfway with warm water. Sprinkle some pepper into the water to represent particles in the ocean. Put a colored ice cube into the jar. Draw and describe observations. (T/E 2.2)
		Earth's History	
12	Give examples of how the surface of the earth changes due to slow processes such as erosion and weathering, and rapid processes such as landslides, volcanic eruptions, and earthquakes.	To demonstrate the influence of vegetation on erosion, put soil in two shallow rectangular baking pans. Cover one pan with a layer of sod. Elevate one end of each pan. Compare and discuss the erosion caused by equal amounts of water running down each slope.	Identify one manmade attribute that slows the erosion process (e.g., hay bales used at a construction site, silt fence protecting sand dunes) and one attribute that accelerates it (e.g., paving a parking lot, cutting trees). Relate these to natural systems. (T/E 2.1, 2.4)
		Grades 6 to 8	
		Mapping the Earth	
1	Recognize, interpret, and be able to create models of the earth's common physical features in various mapping representations, including contour maps.	Choose a small area of unpaved, sloping ground in the schoolyard or a park. Create a scale contour map of the area. Include true north and magnetic north.	

Earth's History

6	Describe and give examples of ways in which the earth's surface is built up and torn down by natural processes, including deposition of sediments, rock formation, erosion, and weathering.	Observe signs of erosion and weathering in local habitats and note seasonal changes.
		Visit local sites following storm events and observe changes. 32
7	Explain and give examples of how physical evidence, such as fossils and surface features of glaciation, supports theories that the earth has evolved over geologic time.	Make a timeline showing index fossils. Discuss which of these fossils are actually found in New England. Discuss why some may be missing from local rocks.

Appendix K-2: Life Science Frameworks

Pre-K to 2

	Learning Standard	IDEAS FOR DEVELOPING INVESTIGATIONS AND LEARNING EXPERIENCES	SUGGESTED EXTENSIONS TO LEARNING IN TECHNOLOGY/ENGINEERING
		Characteristics of Living Things	
1	Recognize that animals (including humans) and plants are living things that grow, reproduce, and need food, air, and water.	Draw and record the growth of a plant grown from seeds with different light exposures (vary the duration and intensity of light exposure).	Design and construct a habitat for a living organism that meets its needs for food, air, and water. (T/E 1.1, 1.2, 1.3)
2	Differentiate between living and nonliving things. Group both living and nonliving things according to the characteristics that they share.	Compare and contrast groups of animals (e.g., insects, birds, fish, mammals) and look at how animals in these groups are more similar to one another than to animals in other groups.	
3	Recognize that plants and animals have life cycles, and that life cycles vary for different living things.	Using either live organisms or pictures/models, observe the changes in form that occur during the life cycle of a butterfly or frog. Discuss the life cycle of a tree.	Design and build a habitat for a living organism that can be modified to meet the changing needs of the organism during its life cycle. (T/E 1.1, 1.2)
		Heredity	
4	Describe ways in which many plants and animals closely resemble their parents in observed appearance.	Look at and discuss pictures of animals from the same species. Observe and discuss how they are alike and how they are different.	
		Evolution and Biodiversity	
5	Recognize that fossils provide us with information about living things that inhabited the earth years ago.	Look at a variety of fossils or pictures of fossils, including plants, fish, and extinct species. Guess what living organisms they might be related to.	Make a fossil print of plant leaves using clay or putty. (T/E 1.1, 1.2)
		Living Things and Their Environment	
6	Recognize that people and other animals interact with the environment through their senses of sight, hearing, touch, smell, and taste.	Observe small animals in the classroom while they find food, water, shelter, etc. Talk about how people use their senses every day.	Design and build an ant farm. Observe how ants use their senses and how they communicate to each other the location of a food source. (T/E 1.1, 1.2, 1.3)

7	Recognize changes in appearance that animals and plants go through as the seasons change.	Observe and record changes in plants (e.g., trees, flowers, grass) on the playground and around the school during fall, winter, and spring.	Observe and record changes in plants (e.g., trees, flowers, grass) on the playground and around the school during fall, winter, and spring.
8	Identify the ways in which an organism's habitat provides for its basic needs (plants require air, water, nutrients, and light; animals require food, water, air, and shelter).	Create a garden habitat that will attract and provide shelter for birds and butterflies. Research and plant appropriate flowers.	Have students draw pictures of their houses and an animal's habitat. Discuss differences and similarities (e.g., type of materials used to build each shelter). (T/E 1.3) Massachusetts

Grades 3 to 5

Characteristics of Plants and Animals

1	Classify plants and animals according to the physical characteristics that they share.	Sort plant and animal pictures based on physical characteristics. Use a dichotomous key to identify plants.	Create a simple chart to classify plants and animals that are common to the school's geographical area. (T/E 2.2)

Structures and Functions

2	Identify the structures in plants (leaves, roots, flowers, stem, bark, wood) that are responsible for food production, support, water transport, reproduction, growth, and protection.	Observe plant/pollinator interaction and seed dispersal methods. Study maple trees and go maple sugaring. Identify the structures in the maple tree and their functions.	Collect plants. Make a detailed drawing of a plant. Identify and label its major structures (i.e., leaves, flowers, stems, roots, seeds). Describe the function of each structure. (T/E 2.2, 2.3)
3	Recognize that plants and animals go through predictable life cycles that include birth, growth, development, reproduction, and death.	Grow plants from seed. Document the complete life cycle of the plant. Describe emergence of structures and the functions of these structures. Record changes in height over time. Graph the data.	Design and construct a habitat for a small animal (e.g., insect, butterfly, frog) that has adequate space and contains the necessities for survival. The habitat should allow for observation of the animal as it goes through the stages of its life cycle. (T/E 1.1, 1.2, 2.1, 2.2, 2.3)
4	Describe the major stages that characterize the life cycle of the frog and butterfly as they go through metamorphosis.	Using either live organisms or pictures/models, observe the changes in form that occur during the life cycle of a butterfly or frog.	

5	Differentiate between observed characteristics of plants and animals that are fully inherited (e.g., color of flower, shape of leaves, color of eyes, number of appendages) and characteristics that are affected by the climate or environment (e.g., browning of leaves due to too much sun, language spoken).	Make frequency tables of the number of students with certain inherited physical traits, e.g., eye color, hair color, earlobe free or attached.	
		Adaptations of Living Things	
6	Give examples of how inherited characteristics may change over time as adaptations to changes in the environment that enable organisms to survive, e.g., shape of beak or feet, placement of eyes on head, length of neck, shape of teeth, color.	Compare and contrast the physical characteristics of plants or animals from widely different environments (e.g., desert vs. tropical plants, aquatic vs. terrestrial animals). Explore how each is adapted to its environment.	Discuss how engineers design things by using their knowledge of the ways that animals move (e.g., birds and wings influence airplane design, tails and fins of aquatic animals influence boat design). (T/E 2.4)
7	Give examples of how changes in the environment (drought, cold) have caused some plants and animals to die or move to new locations (migration).	Investigate how invasive species out-compete native plants (e.g., phragmites and purple loosestrife). Discuss how some native plants die as a result.	
8	Describe how organisms meet some of their needs in an environment by using behaviors (patterns of activities) in response to information (stimuli) received from the environment. Recognize that some animal behaviors are instinctive (e.g., turtles burying their eggs), and others are learned (e.g., humans building fires for warmth, chimpanzees learning how to use tools).	Discuss how newly born sea turtles find their way to the ocean. Discuss how pets are trained to learn new tricks. Discuss how migrating birds navigate.	

9	Recognize plant behaviors, such as the way seedlings' stems grow toward light and their roots grow downward in response to gravity. Recognize that many plants and animals can survive harsh environments because of seasonal behaviors, e.g., in winter, some trees shed leaves, some animals hibernate, and other animals migrate.	Discuss the actions that coastal species take to adjust to the changing levels of the tide. Observe an earthworm placed on top of soil in a container that is exposed to light. Discuss how its ability to sense light helps it survive (by burrowing) and how its structure allows it to burrow through soil. Set a germinating bean in a glass filled with water next to an asymmetric source of light. Allow the root and stem to grow a few inches. Rotate the bean so that the roots are now touching the water at an angle and the stem is away from the light source. Observe how the root system and stem respond to this change by changing their direction of growth.	
10	Give examples of how organisms can cause changes in their environment to ensure survival. Explain how some of these changes may affect the ecosystem.	Discuss the importance of wetlands to human survival.	Brainstorm and sketch items in the home that do help or could help humans survive (e.g., heater for warmth, stove to cook). (T/E 2.1, 2.2) 48
		Investigate how an invasive species changes an ecosystem. Research local projects where humans are changing the environment to ensure a species' survival.	
Energy and Living Things			
11	Describe how energy derived from the sun is used by plants to produce sugars (photosynthesis) and is transferred within a food chain from producers (plants) to consumers to decomposers.	Make a food chain. Begin with the sun as the source of energy and end with decomposers. Create links that show the relationships of plants and animals in the chain. Show the direction of the flow of energy. Discuss results if various links in the chain are broken.	Design and build a compost bin. Use a thermometer to measure the temperature rise during composting. Discuss where heat (energy) comes from (decomposers metabolize energy stored by producers and consumers). (T/E 1.2)

Grades 6 to 8

Classification of Organisms

1	Classify organisms into the currently recognized kingdoms according to characteristics that they share. Be familiar with organisms from each kingdom.	

Evolution and Biodiversity

10	Give examples of ways in which genetic variation and environmental factors are causes of evolution and the diversity of organisms.	
11	Recognize that evidence drawn from geology, fossils, and comparative anatomy provides the basis of the theory of evolution.	Is the pterodactyl a flying reptile or the ancestor of birds? Discuss both possibilities based on the structural characteristics shown in pterodactyl fossils and those of modern birds and reptiles.
12	Relate the extinction of species to a mismatch of adaptation and the environment.	Relate how numerous species could not adapt to habitat destruction and overkilling by humans, e.g., woolly mammoth, passenger pigeon, great auk.
13	Give examples of ways in which organisms interact and have different functions within an ecosystem that enable the ecosystem to survive.	Study several symbiotic relationships such as oxpecker (bird) with rhinoceros (mammal). Identify specific benefits received by one or both partners.
14	Explain the roles and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web.	Distribute pictures of various producers, consumers, and decomposers to groups of students. Have each group organize the pictures according to the relationships among the pictured species and write a paragraph that explains the roles and relationships.

Appendix K-3: Physical Science Frameworks

Physical Science (Chemistry and Physics)

Pre-K to 2

	Learning Standard	IDEAS FOR DEVELOPING INVESTIGATIONS AND LEARNING EXPERIENCES	SUGGESTED EXTENSIONS TO LEARNING IN TECHNOLOGY/ENGINEERING
		Observable Properties of Objects	
1	Sort objects by observable properties such as size, shape, color, weight, and texture.	Manipulate, observe, compare, describe, and group objects found in the classroom, on the playground, and at home.	Predict from looking at the shape of a simple tool or object what actions it might be used for (e.g., pliers, letter opener, paperweight). (T/E 1.2, 2.1)
		Position and Motion of Objects	
3	Describe the various ways that objects can move, such as in a straight line, zigzag, back-and-forth, round-and-round, fast, and slow.	Use a spinning toy (e.g., a top) to explore round-and-round motion and a rocking toy (e.g., a rocking horse) to explore back-and-forth motion.	Using construction paper and glue, design a three-dimensional object that will roll in a straight line and a three-dimensional object that will roll around in a circle. (T/E 1.3, 2.1)
		Grades 3 to 5	
		Properties of Objects and Materials	
1	Differentiate between properties of objects (e.g., size, shape, weight) and properties of materials (e.g., color, texture, hardness).	Gather a variety of solid objects. Collect data on properties of these objects, such as origin (human-made or natural), weight (heavy, medium, light), length, odor, color, hardness, and flexibility.	Given a variety of objects made of different materials, ask questions and make predictions about the hardness, flexibility, and strength of each. Test to see if the predictions were correct. (T/E 1.1)

Appendix L: Discovery Box Descriptions

Maria Mitchell Association Discovery Boxes		
Box Topic	**Science Standards Addressed**	**Grades**
Five Senses	Physical Science #1 Life Science #6	K
Weather	Earth & Space Science #3, 4, 5 Life Science #6, 7	K to 1
Life Cycles & Adaptations	Life Science #2, 3, 4, 6	2 to 4
Weather & Climate	Earth & Space Science #6, 7, 8, 9, 10, 14	2 to 5
Rocks & Minerals	Earth & Space Science #1, 2, 3	3 to 5
Earth Cycles	Earth & Space Science #13, 14, 15	3 to 5
Earth's History & Fossils	Earth & Space Science #12	3 to 5
Potential & Kinetic Energy	Physical Science #4 Technology/Engineering #2, 3	4 to 5
Soil Formation	Earth & Space Science #4, 5	4 to 5
Alternative Energies	Physical Science #4, 5, 6, 7 Technology/Engineering #1.2, 2.2, 2.3	5+

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